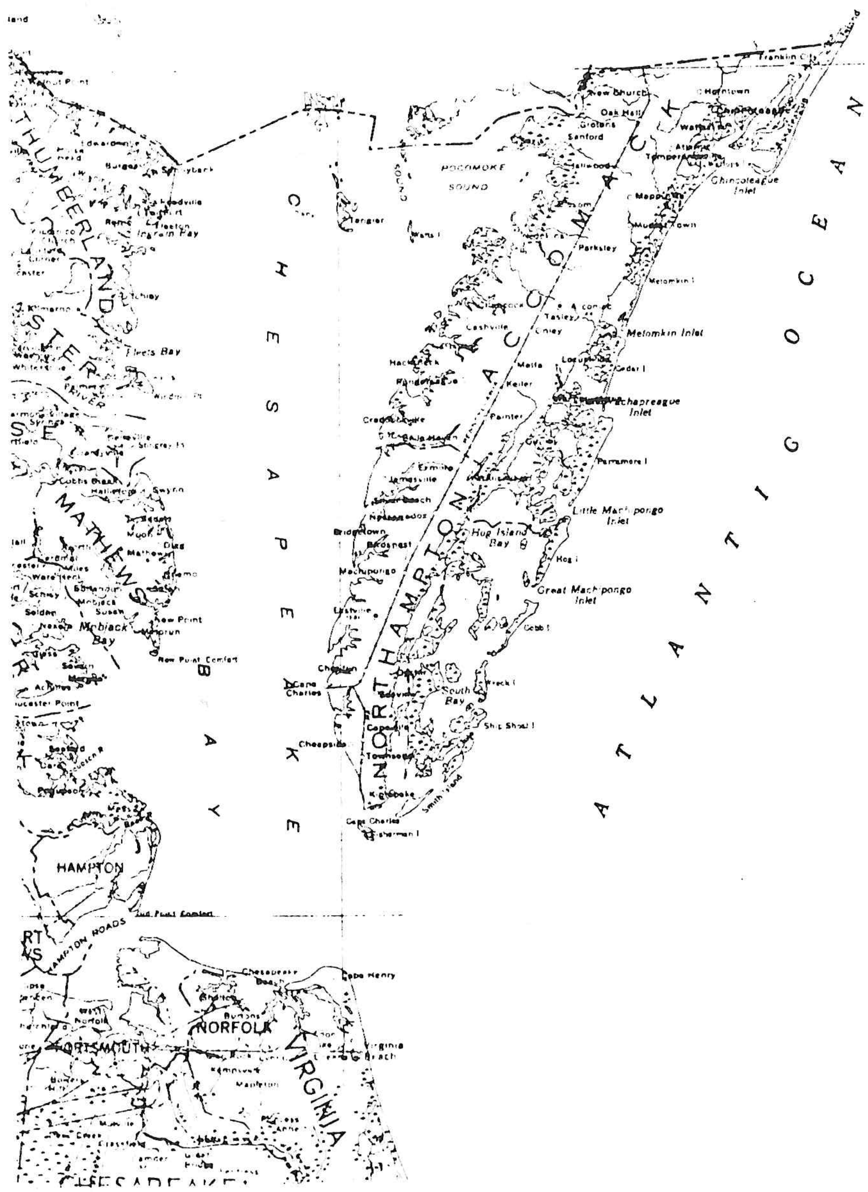
GROUNDWATER CONDITIONS
IN THE
EASTERN SHORE OF VIRGINIA



Commonwealth of Virginia
State Water Control Board
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Errata Sheet

		Page
Page iii, bottom line: add	CHAPTER V AVAILABILITY OF WATER	47

Page ix, lines 27 and 28: change to read "problems, will a complete assessment of future water supply on the Virginia Eastern Shore be possible."

Page 28: The three horizontal arrows on the right side of the diagram should point to the east instead of the west.

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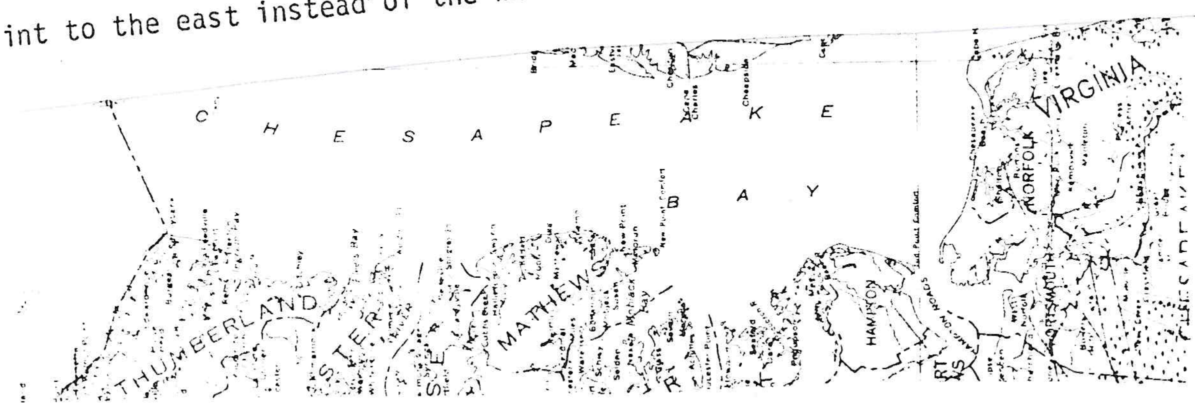

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SUMMARY

This study was designed to determine groundwater conditions, to evaluate groundwater problems, and to formulate recommendations with respect to development and management of this resource on the Eastern Shore. It was initiated in response to a Northampton County Board of Supervisors' resolution to implement state supervision of the county's groundwater resource. Existing data from previous investigations were combined with recent data to constitute the basic data input for this study.

The major aquifers on the Eastern Shore are composed of the discontinuous sands of the Yorktown and underlying St. Marys formations of Miocene Age. These aquifers are artesian aquifers confined below a veneer of sediments 40 to 120 feet thick. Most groundwater withdrawals come from the artesian aquifers at depths of between 65 and 300 feet. Yields of at least 100 gpm generally may be expected from properly developed wells, 6 inches or more in diameter. Due to the lenticular, rather than continuous nature of these aquifers, numerous test wells are often needed to determine optimum locations for permanent wells.

The quality of the water of the artesian aquifers is generally good, though generally moderately hard, with localized iron problems evident. Freshwater occurs most often at depths above 300 feet, but locally, freshwater may be found only at depths above 100 feet.

Regional flow in the artesian aquifers is generally from the central ridge toward the Bay and Ocean. Groundwater recharge to these aquifers occurs by vertical leakage from the water table aquifer. The generally low storage coefficient and transmissivities found for these major aquifers indicate that extensive cones of depression will develop when these aquifers are heavily pumped.

The water table aquifer is used to a lesser extent on the Eastern Shore than the underlying artesian aquifers. The water table aquifer is a discontinuous sand found at depths above 100 feet. Most wells in the water table aquifer are small diameter wells and their average yield is 17 gpm. A few high yield, larger diameter wells with yields averaging 100 gpm have been developed in Accomack County. The higher storage coefficients and transmissivities of the water table aquifer indicate that large pumpage within the water table aquifer would lower water levels less than if the pumpage was located in the Yorktown or St. Marys aquifers.

In almost all instances, the water table aquifer provides a poorer quality water than the deeper artesian aquifers. Characteristically, it is low in dissolved solids and high in iron. Locally, high chlorides and nitrates may be found. Chlorides are encountered in tidal zones, whereas the presence of nitrates may be indicative of surface contamination. Again, test wells may be necessary to determine the location of suitable quality water.

Groundwater levels on the Eastern Shore have remained relatively constant since the 1900's, except in specific localities where heavy groundwater withdrawals from the artesian aquifers have caused cones of depression to develop, thus causing artesian groundwater levels to decline significantly in sections of Accomack County. It should be noted that these well fields have affected private wells within their cones of depression. However, no major groundwater level declines have been observed in Northampton County at the present time.

As previously mentioned, highly mineralized water with a high chloride content can generally be expected at depths below 300 feet and locally at shallower depths. The lateral saltwater-freshwater interface borders the marshland which bounds the Peninsula on all sides but the north. No changes were observed in the position of the saltwater-freshwater interface during the 70 years for which there is chloride data. The present saltwater-freshwater interface is a natural condition which has stablilized. That is to say, there is no evidence of significant saltwater intrusion occurring on the Eastern Shore at the present time. But it is possible that increases in water withdrawals may create saltwater intrusion problems in the future.

The water table aquifer on the Eastern Shore has been exposed to numerous pollutants, such as domestic sewage, feedlots and industrial wastes, and may be expected to become increasingly more contaminated as a result of future development and associated cortege of pollutants. There is no evidence of significant groundwater contamination to the deeper artesian aquifers at the present time, but these aquifers may also be expected to become increasingly polluted as future agriculture, industry and domestic development proceeds, since increased pumpage will accelerate vertical recharge and thus may induce the vertical flow of contaminants where wastes are located within large cones of depression.

Inspection of present water use of the Eastern Shore indicates that water demand projected to the year 2000 can probably be satisfied by further groundwater development. However, if future development on the Shore is substantially greater than predicted by the State of Virginia (1974), future water demand may not be easily satisfied. The three major groundwater problems, water level declines, saltwater intrusion, and groundwater contamination, which affect the availability of groundwater for beneficial uses must be considered in order to arrive at reliable figures for future water supply on the Eastern Shore. A computer model could be designed to evaluate physical and chemical parameters to determine the degree to which these three groundwater problems on the Eastern Shore will limit future groundwater supply. Only after an estimate is made of the effect of these three major problems, will a complete assessment of future water supply on the Virginia Eastern Shore will be possible.

ACKNOWLEDGEMENTS

This Agency wishes to express its gratitude to the following Agencies and individuals who provided data and information to make this report possible: Bundick Well and Pump, Boggs Water and Sewage, Blake and Company, Sydnor Hydrodynamics, and Layne-Atlantic Company, Perdue, Inc., Holly Farms Poultry Products, the Town of Chincoteague, Virginia Division of Mineral Resources, United States Geological Survey, the Division of State Planning and Community Affairs, Accomack-Northampton Planning District Commission, Virginia Department of Health, and the many industries, towns, businesses and private well owners on the Virginia Eastern Shore.

This report was prepared by E. A. Siudyla, Regional Geologist with the State Water Control Board's Tidewater Regional Office, L. S. McBride being Director of this Office, and J. A. Brown, Director of its Division of Water Control Management. It was a joint effort with the Board's headquarters Bureau of Water Control Management, D. F. Jones, Director, under the guidance of E. W. Ramsey, Director of the Hydrologic Division, and T. L. Swearingen, Principal Geologist, and with the advice of M. A. Saint-Pe', Ph.D., Certified Professional Geologist. The report, however, is more a product of the State Water Control Board, E. T. Jensen, Executive Secretary than of any of the above individuals, except E. A. Siudyla.

CHAPTER I

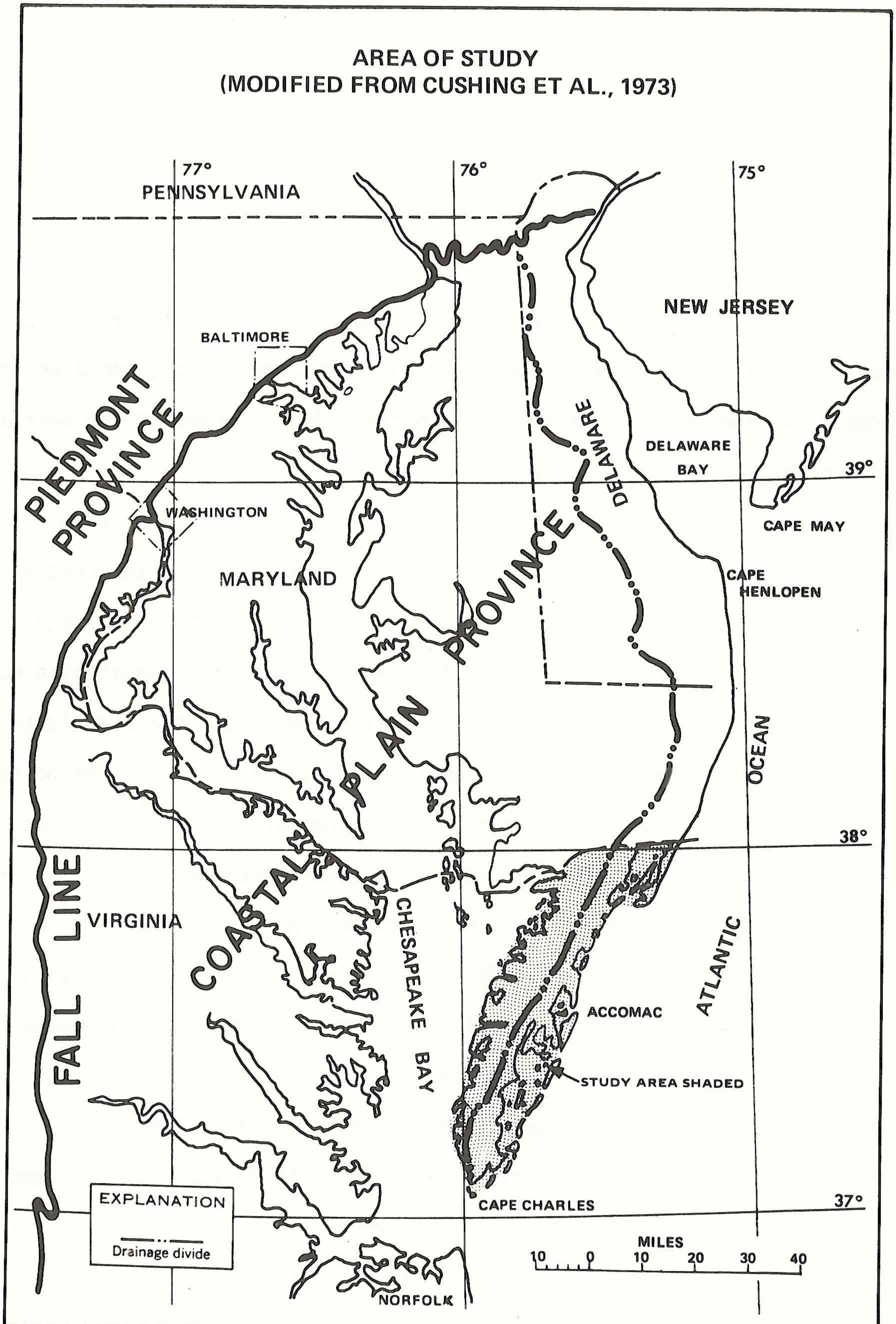
INTRODUCTION

Location and General Features

The Eastern Shore of Virginia, about 696 square miles in area, lies in the Eastern Coastal Plain Province and occupies the southern tip of the Delmarva Peninsula. It is bounded by saltwater on all sides, except the north which is bordered by the Maryland mainland, with the Atlantic Ocean to the east and the Chesapeake Bay to the west and south (Plate 1).

A flat relief characterizes the area, with its central part forming a plateau, about 45 feet above mean sea level in maximum elevation. From the central northeast-southwest trending divide, the contour gradually slopes toward the dissected Atlantic and Bay shorelines. The soil is generally sandy and vegetation mainly consists of wooded areas alternating with cultivated land. Drainage is provided by numerous small streams which widen upon reaching the tidal marshes or open bays. On the Atlantic Coast, a string of long and narrow barrier islands enclose the wetlands. The average temperature ranges from 40 degrees Fahrenheit in January to 78 degrees Fahrenheit in July. Precipitation measured in the last 32 years averaged 43 inches annually, with the bulk occurring in the fall and winter.

Administratively, the area is divided into Accomack and Northampton Counties and into several small towns within each county. The 1970 population was 43,446 with 29,004 in Accomack County and 14,442 in Northampton County. Population projections by the Virginia Division of State Planning and Community Affair (1975) for the year 2000 were estimated to be 32,800 and 18,870 for Accomack and Northampton Counties, respectively. The low population density



Source: Virginia State Water Control Board

PLATE NO. 1

of 62 inhabitants/square mile indicates the rural nature of the area. The population is unevenly distributed throughout the area, with the major towns being Cape Charles, Exmore, Onancock, Parksley and Chincoteague. The major economic activity is centered around agriculture and agribusiness with considerable activity in tourism and shellfish. Future offshore oil and gas exploration and development may establish a petroleum based economy in the near future.

Purpose and Scope

This study was commissioned to determine groundwater conditions, to evaluate groundwater problems, and to formulate recommendations with respect to development and management of this resource on the Eastern Shore. Since low relief, coupled with scarcity of streams with adequate flow, prohibits the development of large surface water supplies, groundwater is the principal source of water for domestic, industrial, and agricultural uses. Most groundwater has been produced from aquifers above 300 feet below mean sea level (MSL). The increasing chloride content of groundwater below 300 feet limits future development of the deeper aquifers. It is appearent that the economic growth on the Eastern Shore depends on maintaining an adequate water supply from these freshwater aquifers.

Legal Background

This study was initiated in response to the Northampton County Board of Supervisors' resolution to implement state supervision of the county's groundwater resources. With the purpose of state implemention in mind, the Northampton County Board of Supervisors' resolution of November 7, 1974 requested the county to be designated a Critical Groundwater Area in accordance with Title 62.1, Chapter 3.4 (The Groundwater Act of 1973) of the Code of Virginia (1950), as amended. In accordance with the above law, the Virginia

State Water Control Board commissioned this study to analyze the need for the initiation of a critical groundwater proceeding for the Virginia Eastern Shore in response to Northampton County's request.

Critical Groundwater Area designation proceedings may be initiated whenever the State Water Control Board has reason to believe that:

(1) Groundwater levels (elevations relative to mean sea level of water table or of artesian water head) in the area in question are declining or have declined execessively; or

(2) The wells of two or more groundwater users within the area in question interfere substantially with one another; or

(3) The available groundwater supply in the area in question is being or is about to be overdrawn; or

(4) The groundwater in the area in question has been or reasonably may be expected to become polluted.

Previous Investigations

A number of investigators studied the groundwater conditions on the Eastern Shore. Sanford (1913) discussed the occurrence of groundwater in the area. Although Sinnott and Tibbitts (1968) studied the occurrence and use of groundwater in the area, they did not conduct any detailed hydrogeologic investigations. The Virginia Division of Water Resources (1972) evaluated the local groundwater level declines and associated problems related to increased pumpage in central Accomack County. From this study, it was concluded that accelerated or increased groundwater development predictably would cause various economic, contamination and political problems. Cushing et al. (1973) who evaluated the groundwater resources of the entire Delmarva Peninsula, concluded that large quantities of groundwater are available. He recommended that future large supplies be developed in the Pleistocene water table aquifer because it is the most extensive, most permeable, and most productive aquifer.

Other investigations were related to the groundwater conditions of the Eastern Shore of Virginia. Back (1966) determined saltwater-freshwater boundaries and estimated regional flow patterns for aquifers in the Northern Atlantic Coastal Plain. The stratigraphy of the Coastal Plain of Virginia was studied by Teifke (1973). Brown et al. (1973) discussed the structural geology, stratigraphy, and relative permeability of strata in the North Atlantic Coastal Plain. Onuschak (1973) derived environmental geologic maps showing geomorphic features and indicating the general geologic processes operating in the area. Onuschak concluded that the environmental information can do much to show the nature of the natural resources available and how they can be best utilized to produce the maximum benefit at minimum total cost.

Methods of Investigation

Existing hydrogeologic data from Sanford (1913), Rasmussen and Slaughter (1955), Sinnott and Tibbitts (1968), and Virginia Division of Water Resources (1972) were combined with recent data to constitute the basic data input for this study. The following data components were compiled to achieve the objectives of this study:

(1) Transmissivities and storage coefficients for the major aquifers of the Eastern Shore were estimated from Maryland transmissivities and storage coefficients and from specific capacity data. Transmissivities for the artesian aquifers were estimated from the available specific capacity data of water well contractors using the graphical method of Walton (1970)(Appendix A). Transmissivities

for the water table aquifer and storage coefficients for both the water table and artesian aquifers were estimated from Maryland values which were estimated from pump test data using the Theis non-equilibrium formula (Rasmussen and Slaughter, 1955).

(2) Water levels or piezometric levels for wells within the major aquifers were used to determine regional flow patterns and to indicate changes in water levels with time. Water level data prior to 1968 was obtained from the publications listed above. More recent data from 1968 to present was obtained from the records of water well contractors (Appendix B). The wells were obtained partly on the basis of their proximity to highly pumped areas and partly for obtaining a representative water level network within the major aquifers.

(3) Groundwater quality data from water wells was used to determine the chemical distribution within the major aquifers and to indicate changes in chemical parameters with time. Generally, data prior to 1970 was obtained from Sanford (1913) and Sinnott and Tibbitts (1968). More recent data was obtained from the Virginia State Health Department and the Virginia State Water Control Board. Twenty-two chemical parameters were analyzed and the well screen depths for each well sample were obtained (Appendix C). In addition, 85 samples were collected February, 1975, primarily to determine the chloride distribution with respect to depth and aquifer (Appendix D).

(4) Water well design and aquifer development data obtained from Sinnott and Tibbitts (1968) and water well contractors were used to determine the nature and extent of development within the major aquifers. (Appendix A and B)

(5) Costs incurred by a number of water well owners in areas of high water use were obtained from water well contractors and affected well owners (Appendix E).

(6) Groundwater pumpage data was obtained form the State Health Department and the State Water Control Board (Appendix F).

CHAPTER II

THE AQUIFERS

Geologic Setting

The Delmarva Peninsula is a part of the Atlantic Coastal Plain that extends from Long Island, New York, southward to the Gulf of Mexico. Crustal movements along the Atlantic continental margin have produced a seaward slope on the crystalline-rock basement surface (Plate 2). Areas west to northwest of the Fall Line were uplifted during the movements 430 to 280 million years ago and underwent erosion while areas east to southeast of the Fall Line were depressed and became centers of deposition. The sediments eroded from the uplifted areas filled these depositional basins to the southeast including the Eastern Shore of Virginia.

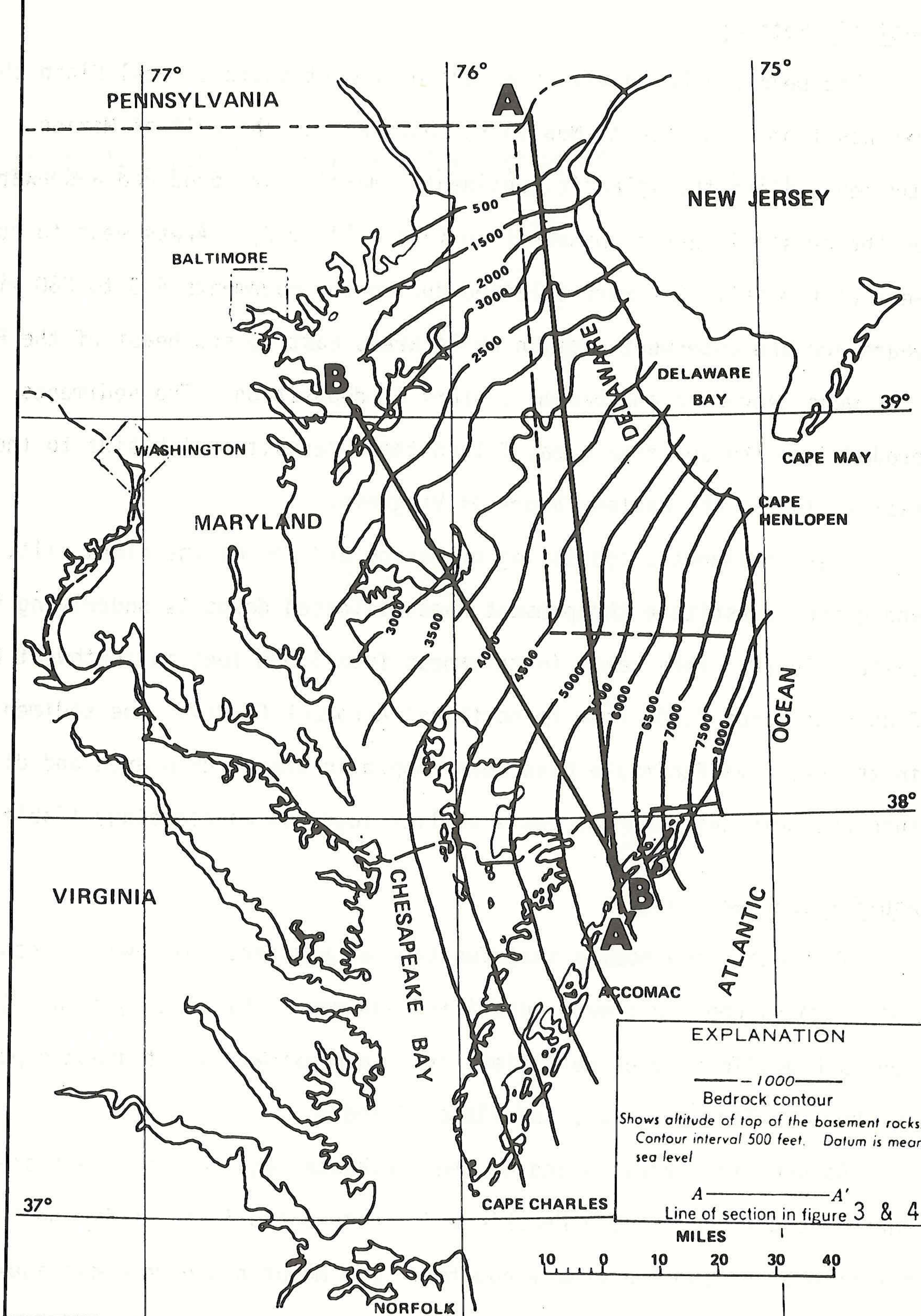
These sediments, consisting of marine and non-marine clay, silt, sand, and gravel, constitute the present unconsolidated deposits underlying the Eastern Shore. They range in thickness from 3,500 feet in southwest Northampton County to about 7,500 feet in northeast Accomack County. The sediments in the Delmarva Peninsula have been mapped in the outcrop area and divided into geologic units on the basis of lithology and paleontology (Table 1).

Aquifer Delineation

The major sand bodies that function as aquifers, over wide areas of the Delmarva Peninsula were identified and mapped by Cushing et al. (1973). Ten such aquifers were identified; their approximate stratigraphic position is shown in Tables 1 and 2 and Plates 3 and 4.

As seen in Plates 3 and 4, the freshwater aquifers on the Eastern Shore include the Miocene Manokin and Pocomoke aquifers within the Yorktown formation, and the Quaternary aquifer. The Manokin and Pocomoke aquifers are not differentiated on the Eastern Shore and will be referred to collectively

CONFIGURATION OF THE TOP OF THE BASEMENT ROCKS
(MODIFIED FROM CUSHING ET AL., 1973)



Source: Virginia State Water Control Board

PLATE NO. 2

Cross-section A-A'
(modified from Cushing et al., 1973)

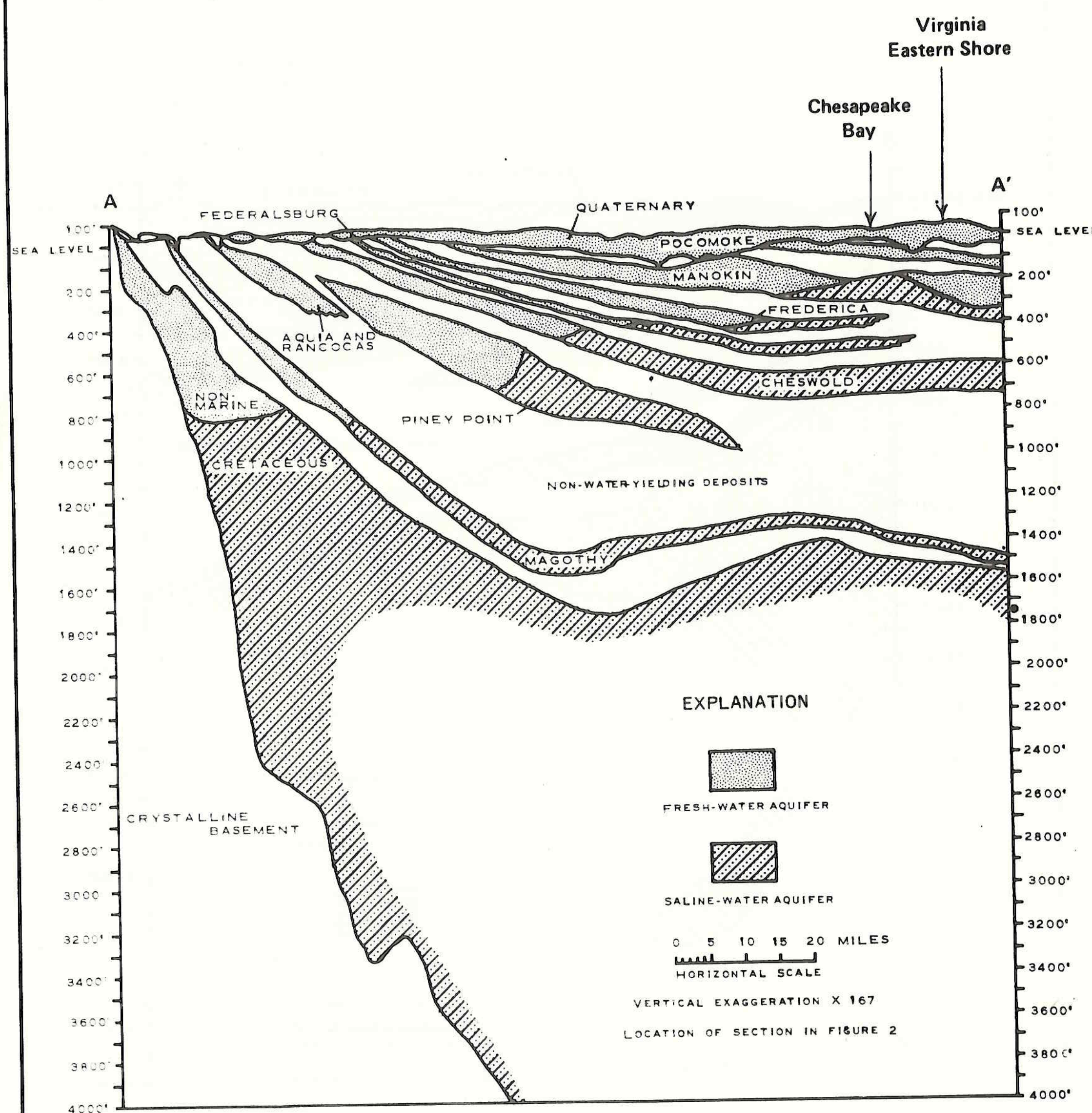
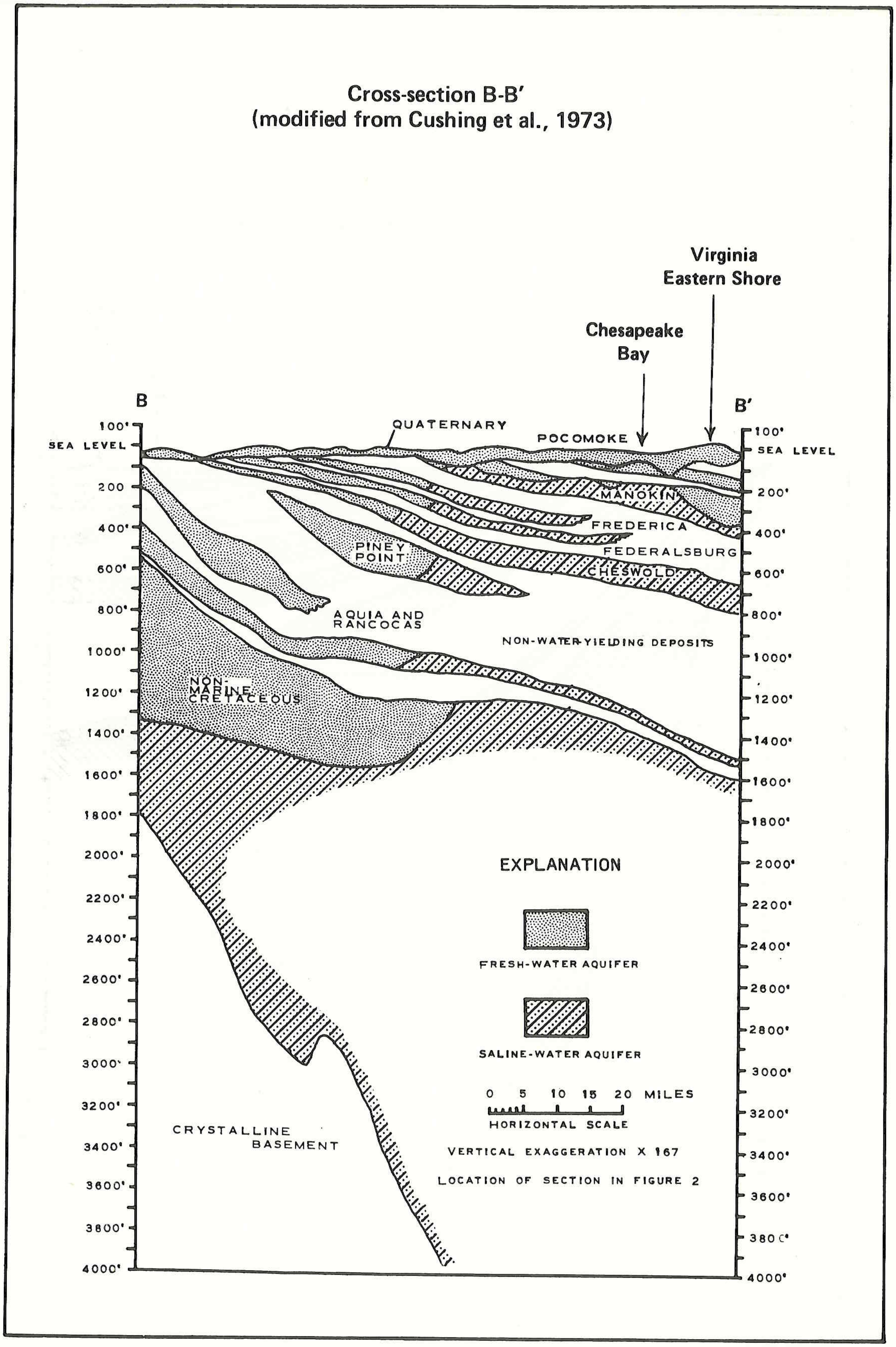


PLATE NO. 3

Source: Virginia State Water Control Board



Source: Virginia State Water Control Board

PLATE NO. 4

Table 1.--Coastal-Plain stratigraphic nomenclature and aquifers of the Delmarva Peninsula (from Cushing et al., 1973)

System	Series	Stratigraphic units: Virginia	Stratigraphic units: Maryland	Stratigraphic units: Delaware	Stratigraphic units: New Jersey	Informal units used in this report	Aquifer names used in this report
Quaternary	Holocene	--------	--------	--------	--------	Quaternary sediments	Quaternary aquifer
	Pleistocene	Columbia Group undivided	Columbia Group undivided	Columbia Group undivided	Cape May Formation Pensauken Formation Bridgeton Formation		
Tertiary	Pliocene (?)	--------	Brandywine Formation	--------	Cohansey Sand	Miocene sediments	Pocomoke aquifer
	Miocene	Chesapeake Group: Yorktown Formation St. Marys Formation Choptank Formation Calvert Formation	Chesapeake Group: Yorktown Formation St. Marys Formation Choptank Formation Calvert Formation	Chesapeake Group undivided	Kirkwood Formation		Manokin aquifer Frederica aquifer Federalsburg aquifer Cheswold aquifer
	Oligocene	Section not present					
	Eocene	Chickahominy Formation Nanjemoy Formation	Piney Point Formation Nanjemoy Formation	Piney Point Formation Nanjemoy Formation	Piney Point Formation Shark River Formation Manasquan Formation	Eocene and Paleocene sediments	Piney Point aquifer
	Paleocene	Aquia Formation	Aquia Formation Brightseat Formation	Rancocas Group: Vincentown Formation Hornerstown Sand	Vincentown Formation Hornerstown Sand		Aquia and Rancocas aquifer
Cretaceous	Upper Cretaceous	Mattaponi Formation	Monmouth Formation Matawan Formation Magothy Formation Raritan Formation	Mount Laurel Sand Matawan Group: Marshalltown Formation Englishtown Formation Merchantville Formation Magothy Formation	Tinton Sand Red Bank Sand Navesink Formation Mount Laurel Sand Wenonah Formation Marshalltown Formation Englishtown Formation Woodbury Clay Merchantville Formation Magothy Formation	Marine Cretaceous sediments	Magothy aquifer
	Lower Cretaceous	Potomac Group: Patapsco Formation Patuxent Formation	Potomac Group: Patapsco Formation Arundel Formation Patuxent Formation	Potomac Formation	Raritan Formation and Potomac Group undifferentiated	Nonmarine Cretaceous sediments	Nonmarine Cretaceous aquifer

Table 2. Geologic units and water-bearing characteristics (from Virginia Division of Water Resources, 1972)

SYSTEM	SERIES	FORMATION	APPROXIMATE THICKNESS	DEPTH TO TOP OF FORMATION	LITHOLOGIC CHARACTER	HYDROLOGIC COMMENTS
Quaternary	Recent			(Datum is 20' above M. S. L.)	Loam soil, sand, silt	Water to low yield shallow wells
	Pleistocene	Princess Anne Pamlico Talbot Penholoway	30' - 80'		Unconsolidated, stratified, lenticular sand & silt with gravel and clay	Water table aquifers; small to moderate yield; may contain iron
Tertiary	Miocene	Yorktown	120'	45'	Gray sands, gray or blue clayey silt	Yields small to moderate, with a few high yield wells; contains aquifers and aquitards
		St. Mary's	135'	165'	Clayey silt & Silty clay, fine sands, Foraminifera	Small to moderate yield; potable water above -300'
		Choptank	140'+	300'	Gray & brown marine sand and clay	Small yield; water high in dissolved solids; generally an aquiclude
		Calvert	450'	440'	Gray diatomaceous silts & clay; lenses of gray sands shell beds, Foraminifera	Generally an aquiclude, with some small aquifers
	Eocene	Chickahominy	150'	890'	Brown glauconitic clay	Aquiclude
		Piney Point (?)	100'	1040'	White quartz sand grading into brown shale; marine	Moderate yield of slightly saline water
		Nanjemoy	100'	1140'	Chalk, trace of glauconite	Not known to yield water
	Paleocene	Brightseat	300'	1240'	Alternate beds of gray, green & brown clay & gray glauconitic sand; marine	Yields water to a few moderate & large capacity wells in Maryland
Cretaceous	Upper Cretaceous	Monmouth(?)	60' (?)	1540'	Dark green glauconitic sand and gray clay with shells & Foraminifera marine	Not known to yield water; electric logs suggest it is an aquiclude
		Matawan(?)	40'	1600'	White silty chalk, gray glauconitic clay, basal fine sand & conglomerate	Not known to yield water; probably an aquiclude
		Magothy	90'	1640'	White, yellow & gray sand inter-bedded with gray & brown shale; lignite; non-marine; unconformable lower boundary	Large to moderate yields to flowing wells in Maryland; electric logs indicate high permeability, but water is highly mineralized
		Raritan	650'	1730'	Intercalated thin sands & shales; lithology indicates deltaic and estuarine deposition	Yields water to a well in Maryland electric logs indicate water to be brackish or salty
		Patapsco Arundel	2000'	2380'	Thick sands and shales; probably deltaic	Not known to yield good water; electric logs indicate water to be brackish or salty
	Lower Cretaceous	Patuxent	950'	4380'	Thick sands and thin shales; lithology indicates fluviatile and alluvial fan	Potential aquifer, but electric logs suggest high-temperature, mineralized water
Triassic	Upper (Newark)		150'	5330'	Upper brown shales, intercalated gray sands & shales; indurated basal conglomerate; lower boundary unconformable	Doubtful aquifer; upper beds are probably aquicludes
Pre-Triassic crystalline Complex				5480'		Probably non-productive

as the Yorktown aquifer in this report. Aquifers below 300 feet are not generally used because of the saline nature of their water (Table 2). In addition, the St. Marys formation, although generally an aquitard in Maryland, is an extensive aquifer on the Eastern Shore (Rasmussen and Slaughter, 1955, and Sinnott and Tibbitts, 1968).

The major aquifers on the Eastern Shore of Miocene and Pleistocene age are of marine origin. The interfingering nature of aquifers, generally sands grading laterally into silts and clays, is characteristic of marine deposition. The presence of foraminifera in the Miocene and Pleistocene sediments indicates marine deposition. The Miocene fossil assemblage is a shallow-water one, from the beach outward to probably not greater than a depth of 300 feet (Todd et al., 1954). The Pleistocene fauna is a cold-water one, typical of areas north of Virginia.

A discussion of the distribution and geologic description of the formations in which the major aquifers are found follows:

St. Marys - The aquifers and aquitards of the St. Marys and Yorktown formations are generally extensive as indicated by electric and geologic log correlations of Sinnott and Tibbitts (1968) and the Division of Water Resources (1972). The St. Marys formation generally occurs below 150 feet in Accomack County and at greater depth in Northampton County (Table 2 and Plate 5). Typically the lithology of the St. Marys is interbedded, blue sandy clay and silty sand with abundant shell fragments. Although the horizons of the St. Marys and Yorktown Formations are continuous, the particle size and distribution is not, causing hydrologic barriers within the water-bearing strata. The dimensions of the sand grains may change rapidly in size with respect to the lateral direction of the aquifer.

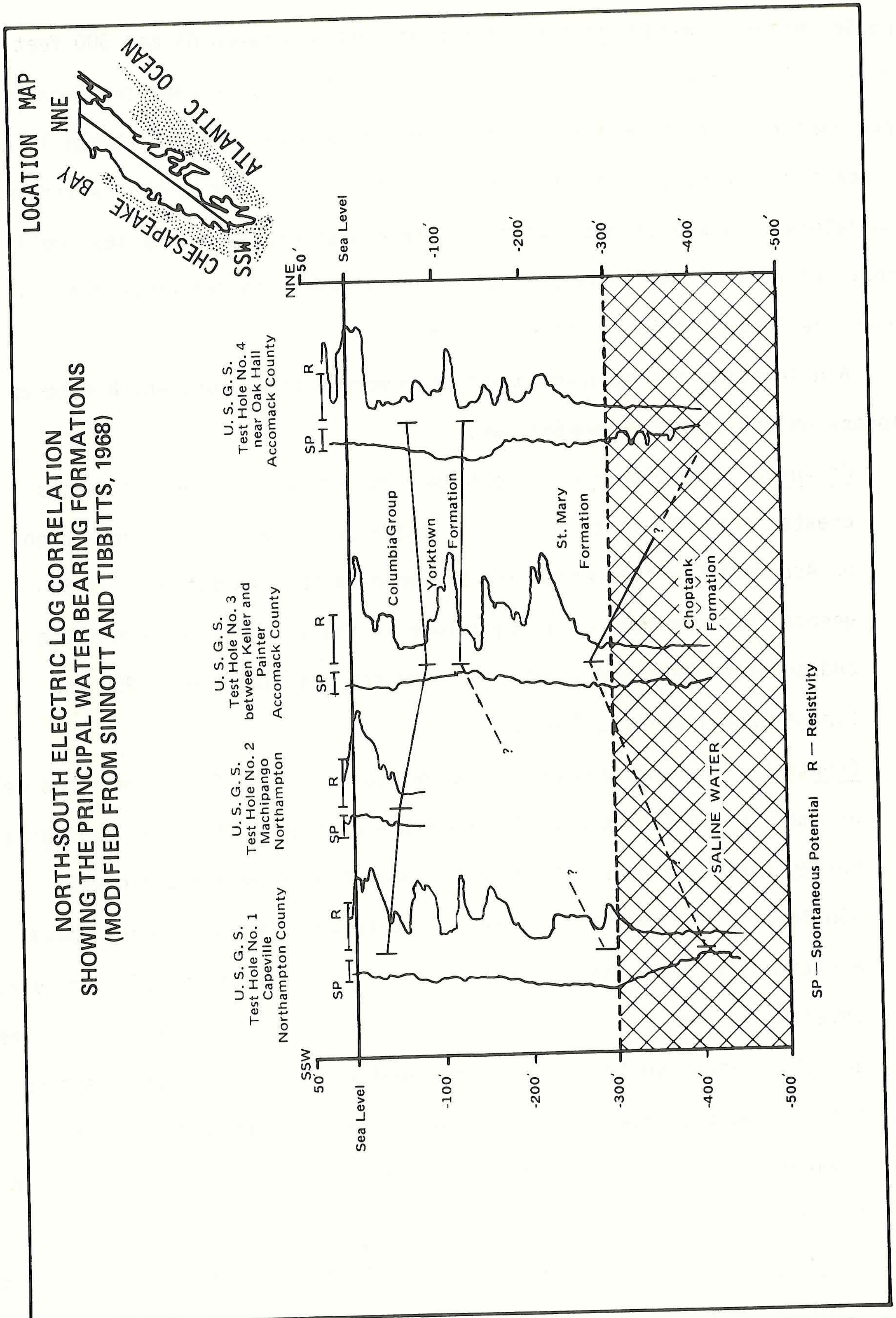
Yorktown - The Yorktown Formation as noted above is similar in nature to the underlying St. Marys formation (Table 1). Most frequently the Yorktown occurs below 60 feet to depths ranging from 140 feet in Accomack County to about 280 feet in Northampton County (Plate 5). The lithology of the Yorktown is generally sand, blue, black or brown clay, and shells.

Columbia Group - The Columbia Group of Pleistocene Age occurs as a veneer 25 to 100 feet, upon the underlying miocene deposits (Plate 5). The lithology is chiefly yellow sand, sandy clay and minor lenses of gravel. Because individual Pleistocene beds commonly interfinger and are of limited areal extent, it is usually not possible to trace them laterally for more than a few hundred feet.

Groundwater Development

Pre-Miocene Aquifers - No wells on the mainland of Accomack or Northampton Counties tap Pre-Miocene aquifers. Two test wells drilled in Northampton County to depths of 1,520 and 1,001 feet showed no suitable aquifers. According to Sanford (1913), the Cape Charles test well showed no "water-bearing sand" between 40 and 1,520 feet. A well in Crisfield, Maryland, about 16 miles west of New Church, Virginia, taps Upper Cretaceous sands at depths of 1,125 to 1,142 feet. This well was test pumped at 330 gpm with a specific capacity of 3 gpm/ft. Several wells on Tangier Island in the Chesapeake Bay (Accomack County) also tap the Upper Cretaceous as well as Eocene aquifers at depths of 860 to 1,100 feet (Appendix B, SWCB No. 100-161, 213, and 214). From the limited data available it appears that water from the Pre-Miocene aquifers on the mainland would generally be brackish and of very limited usefulness (see Groundwater Quality).

Miocene Aquifers - Most of the larger groundwater supplies in Accomack and Northampton Counties are obtained from the sand bodies within the Yorktown



Source: Virginia State Water Control Board

PLATE NO. 5

and St. Marys formation of Miocene Age at depths between 65 and 300 feet (Plate 5). Yields of at least 100 gpm generally may be expected from properly developed wells 6 inches or more in diameter, whereas yields between 10 and 20 gpm may be expected from smaller diameter wells. Due to the lenticular and laterally discontinuous nature of these aquifers, numerous test wells should be drilled initially for larger developments to determine the most favorable locations for permanent wells.

A discussion of the development of numerous formations which make up the Miocene on the Eastern Shore follows:

Calvert - This oldest Miocene formation generally occurs at depths greater than 450 feet (Table 2). There are no wells in Northampton or Accomack Counties which are screened in this formation. It is generally recognized as an aquiclude in the Virginia Eastern Shore and adjacent Maryland Counties (Rasmussen and Slaughter, 1955 and Sinnott and Tibbitts, 1968).

Choptank - The Choptank occurs below depths of 300 feet. Only two wells of small yield (about 5 gpm) tapped the Choptank. A. U. S. Geological Survey test well near Keller in Accomack County penetrated nearly 150 feet of the Choptank but no good water-bearing zones were found. Additionally, even though the Choptank is a permeable aquifer in adjacent Somerset and Worcester Counties in Maryland, it is found to be saline and of limited use (Rasmussen and Slaughter, 1955). It appears from the limited data available that the Choptank formation holds little promise as a potential future source of groundwater in the Eastern Shore of Virginia.

St. Marys - The St. Marys occurs below 150 feet in Accomack County and at greater depths in Northampton County, but it is not usually developed below 300 feet because the water normally is highly mineralized below that depth (Groundwater Quality). Most wells are 2 inches in diameter with yields averaging between 15 and 20 gpm. The highest recorded yield was 275 gpm from an 8 inch well at Exmore Foods in Northampton County which was later abandoned because of the saline content of the water (Sinnott and Tibbitts, 1968). Other reported yields ranged from 115 gpm each from two 4 inch diameter wells, 114 gpm from a 6 inch well, to yields of 194 and 254 gpm from two 8 inch diameter wells.

Yorktown - Most frequently the Yorktown occurs below 60 feet to depths ranging from 140 feet in Accomack County to about 280 feet in Northampton County. Most wells are 2 inches in diameter and yield from 15 to 25 gpm. The highest listed yield of record for any well on the Virginia Eastern Shore occurred in this aquifer. It produced 746 gpm with 37 feet of drawdown and was located at Exmore (165-15). The Exmore Foods well field in Exmore seasonally yields over one million gallons per day from the Yorktown aquifers, the most productive well yielding 350 gpm and having a specific capacity of 10 gpm/ft (Appendix A). An abandoned Cape Charles well once delivered at the rate of 645 gpm from the Yorktown aquifers.

At present, the two largest well fields on the Virginia Eastern Shore produce from multi-screened wells in both the Yorktown and St. Marys aquifers. The largest single water user is Perdue, Inc. in Accomac, which currently pumps 2.1 million gallons per day. Specific capacities of the Perdue wells range from 2.3 to 5.6 gpm/ft with the two most productive Perdue wells having operational yields of 590 gpm (Appendix A). The second largest well field is Holly Farms Poultry Industries which yields 1.1 million gallons per day. The specific capacities of the Holly Farms wells range from 2.8 to 10.2 gpm/ft with operational yields of 100 gpm.

Pleistocene Aquifer - Most wells in the Columbia Group of Pleistocene Age are 1¼ to 2 inches in diameter, and their average yield is 17 gpm per well. Higher yield wells have been predominately developed in Accomack County. An irrigation well near Onancock yielded 450 gpm with 56 feet of drawdown. Two wells (18, 14) operated by the Town of Parksley (in Accomack County) yield about 150 gpm each. The municipal water system for the Town of Chincoteague uses a network of shallow wells pumped as a single composite well. Two systems of 28 and 13 wells, when pumped as a composite unit, produce over 50% of Chincoteague's .2 mgd demand.

At the present time the Pleistocene aquifer on the Virginia Eastern Shore is only slightly developed. Cushing et al. (1973) recommends that future large supplies on the Delmarva Peninsula be developed in the Pleistocene aquifer. Properly designed large supplies comparable in size to the Town of Chincoteague's supply may be developed on the Shore. The Pleistocene aquifer would be especially suitable for use in irrigation since this use does not require a high quality water. Water from the Pleistocene aquifer is generally of a poorer quality than the deeper Yorktown and St. Marys aquifers (See Groundwater Quality).

Aquifer Characteristics

An assessment of the storage and transmissivity capabilities of the aquifers of the Eastern Shore can be estimated from the aquifer coefficients of storage and transmissivity. These coefficients are generally calculated from data obtained from carefully monitored pump tests, using one or more observation wells. No published aquifer constants are available for the Eastern Shore to the best of the author's knowledge. Therefore, transmissivities were estimated from specific capacity data and Maryland transmissivity data and storage coefficients were estimated from Maryland storage coefficient data.

Table 3.--Transmissivities of selected major wells in Accomack and Northampton Counties and adjacent Maryland Counties

SWCB No.	Well Owner	Location	Aquifer	Transmissivity gpd/ft	Storage Coefficient
100-12	Holly Farms #1 Well	Temperanceville	Yorktown and St. Marys	8,000	-
100-11	#2 Well	Temperanceville	Yorktown and St. Marys	7,000	-
100-10	#3 Well	Temperanceville	Yorktown and St. Marys	8,000	-
100-9	#4 Well	Temperanceville	Yorktown and St. Marys	20,000	-
100-196	#5 Well	Temperanceville	Yorktown and St. Marys	11,000	-
100-30	Perdue #1 Well	Accomac	Yorktown and St. Marys	5,000	-
100-26	#2 Well	Accomac	Yorktown and St. Marys	9,000	-
100-29	#3 Well	Accomac	Yorktown and St. Marys	12,000	-
100-195	#4 Well	Accomac	Yorktown and St. Marys	7,000	-
100-20	#4A Well	Accomac	Yorktown and St. Marys	7,000	-
100-5	Exmore Foods #5	Exmore	Yorktown	8,000	-
100-29	#29 Well	Exmore	Yorktown	8,000	-
100-39	#39 Well	Exmore	Yorktown	21,000	-
-	Pocomoke City	Pocomoke City, Maryland	Yorktown	8,000*	.003*
-	Birdseye Foods	Pocomoke City, Maryland	Yorktown	40,000*	.0002*

Table 3.--Transmissivities of selected major wells in Accomack and Northampton Counties and adjacent Maryland Counties

SWCB No.	Well Owner	Location	Aquifer	Transmissivity gpd/ft	Storage Coefficient
-	Ocean City North Well Field	Ocean City, Maryland	Yorktown	10,000*	.0001*
-	North Well Field	Ocean City, Maryland	Yorktown	26,500*	.00001*
-	South Well Field	Ocean City, Maryland	Yorktown	14,000*	.0001*
-	Town of Princess Anne	Princess Anne, Maryland	Yorktown	7,000*	.0002*

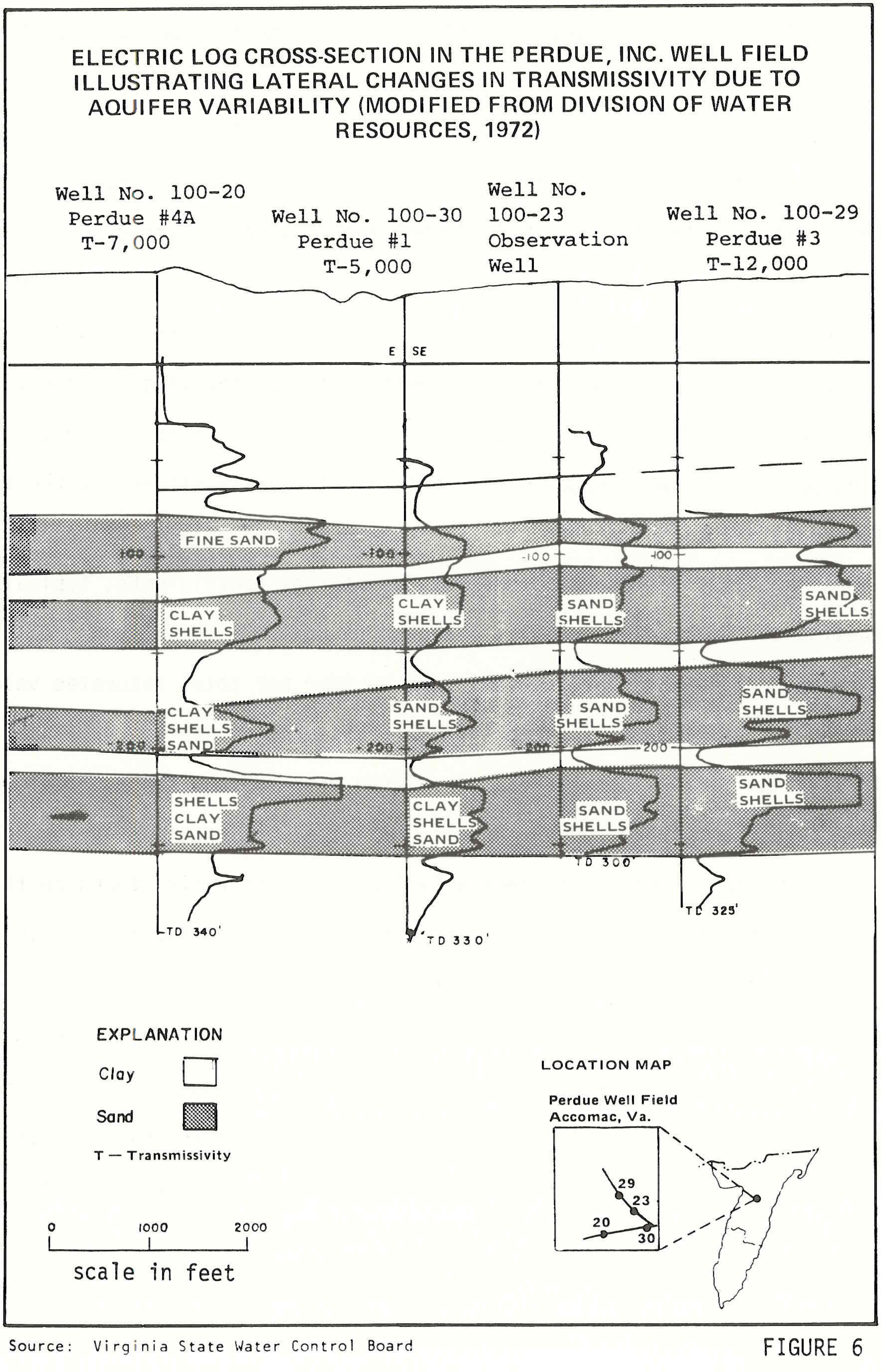
* From Rasmussen and Slaughter, 1955 - calculated using the Theis non-equilibrium formula.

Virginia transmissivity values were estimated from specific capacity values (see Appendix D), using the graphical method in Walton, 1970.

Transmissivities and storage coefficients for the Yorktown and St. Marys aquifers on the Eastern Shore were estimated. The values of transmissivity for the Yorktown and St. Marys aquifers shown in Table 3 were estimated from available specific capacity data (Appendix A). The estimated Virginia transmissivities range from 5,000 to 21,000 gpd/ft with an average of 9,400 gpd/ft. For comparison purposes, transmissivities for adjacent Somerset and Worcester Counties in Maryland average 17,000 and range from 7,000 to 40,000 gpd/ft. An approximate storage coefficient for the Virginia Yorktown and St. Marys aqufers, estimating by averaging Maryland's data, is .0006.

The generally low storage coefficients and transmissivities for the Virginia artesian aquifers indicate that extensive cones of depression will develop when these aquifers are heavily pumped. The storage coefficients, typical of artesian aquifers, are generally expected to be low. The storage coefficient is a measure of the water available in the aquifer per total saturated volume of the aquifer. The localized storage of an artesian aquifer is very small compared to the total storage areas associated with the aquifer. Therefore, water derived from storage during pumping will frequently extend over a several square mile region. Due to the generally low transmissivities found on the Virginia Eastern Shore, the cones of depression, which develop in heavily pumped areas, will tend to be deep and the water level declines substantial.

Considerable variability in transmissivity (Table 3), even in the same well field, generally reflects rapid lateral physical changes in the Yorktown and St. Marys aquifers. Plate 6 shows the variability of the sand bodies in the Perdue well field and the corresponding changes in transmissivities.



Source: Virginia State Water Control Board

FIGURE 6

The sand bodies grade from interbedded sand and clay in numbered wells 100-20 and 100-30 to sand mixed with shell layers in numbered wells 100-23 and 100-29. The transmissivities also change in a similar fashion from 7,000 and 5,000 gpd/ft to 12,000 gpd/ft in response to the greater amount of permeable material present around the 12,000 gpd/ft well. This rapid lateral change in transmissivity illustrates why test drilling should be used prior to the location of large wells or well field sites. In this fashion, the most suitable aquifers which have the highest transmissivity values can be utilized.

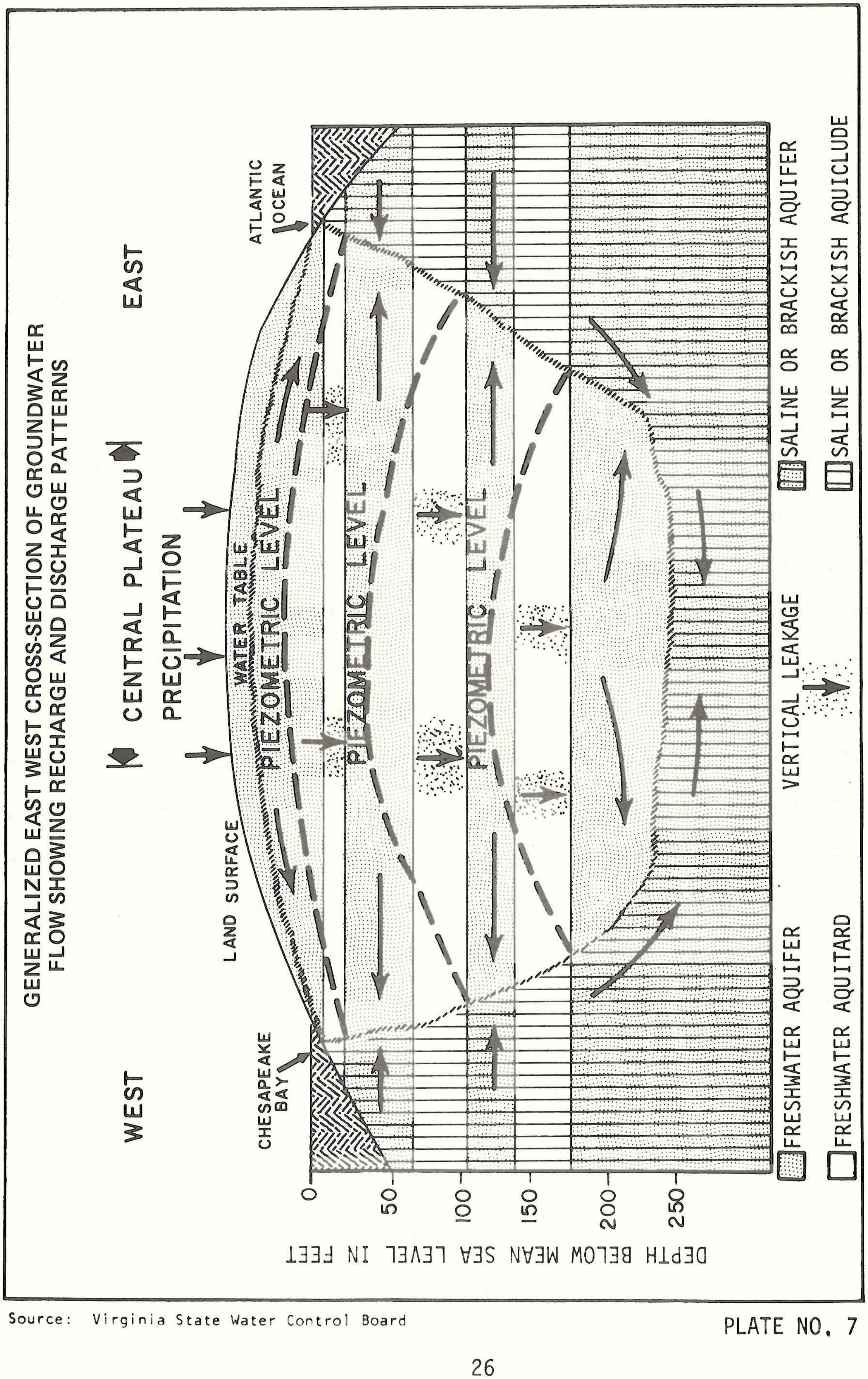
It is also estimated, from Maryland's data (Rasmussen and Slaughter, 1955), that the Pleistocene water table aquifers of Virginia may have storage coefficients ranging from .01 to .20 and transmissivities ranging from 5,000 to 20,000 gpd/ft. Pleistocene storage coefficients and transmissivities are generally higher than the Yorktown and St. Marys storage coefficients and transmissivities. The higher storage coefficients and transmissivities of the water table aquifer indicate that large pumpage within the water table aquifer would lower water levels less than if the pumpage was located in the Yorktown or St. Marys aquifers. Cushing et al. (1973) recommends the use of the Pleistocene aquifer in the future to avoid excessive drawdowns and possible dewatering of the artesian aquifers.

Groundwater Movement

The Pleistocene aquifer is the water table aquifer on the Eastern Shore and hence, receives recharge from rainfall infiltrating the permeable Eastern Shore soil and from the influent seepage of nearby streams. The regional movement of water in the water table aquifer is from areas of high water levels, corresponding to land surface highs of the central ridge toward the low water levels of the Chesapeake Bay and the Atlantic Ocean (Plate 7). The continuous discharge of freshwater from the water table into the saltwater bodies prevents reverse movement of saltwater into the water table aquifer. Heavy pumpage in the water table aquifer will induce saltwater intrusion from the bay or ocean when the cone of depression resulting from pumping intersects the saltwater bodies. A large amount of vertical leakage occurs from the water table aquifer into the underlying Yorktown and St. Marys artesian aquifers.

As previously indicated, downward vertical leakage of freshwater from the water table continuously recharges the underlying Yorktown and St. Marys aquifers. These freshwater aquifers occur under semi-artesian conditions as can be noted from Plate 7. In an unconfined or non-artesian system, rapid vertical recharge would be the expected situation. However, in this case, regional and local aquitards, or confining layers, while inducing the artesian conditions, at the same time inhibit rapid recharge under natural flow conditions. Variations in the permeability of these aquitards have been noted especially in that occurring between the Pleistocene and underlying Yorktown and St. Marys aquifers. Thus, it can be conjectured that where these zones of increased permeability exist, rapid recharge from upper to lower aquifers is significant. This localized pseudo-confined artesian system is what the author defines as semi-artesian conditions.

The regional flow patterns within the Yorktown and St. Marys artesian system is analogous to that of the water table conditions; the flow is from high to low land elevation, toward the Chesapeake Bay and the Atlantic Ocean (Plate 7); vertical leakage is from high to low pressure which is downward toward the saline artesian aquifers. Constant lateral and vertical discharge of freshwater from artesian aquifers inhibits the intrusion of the



Source: Virginia State Water Control Board

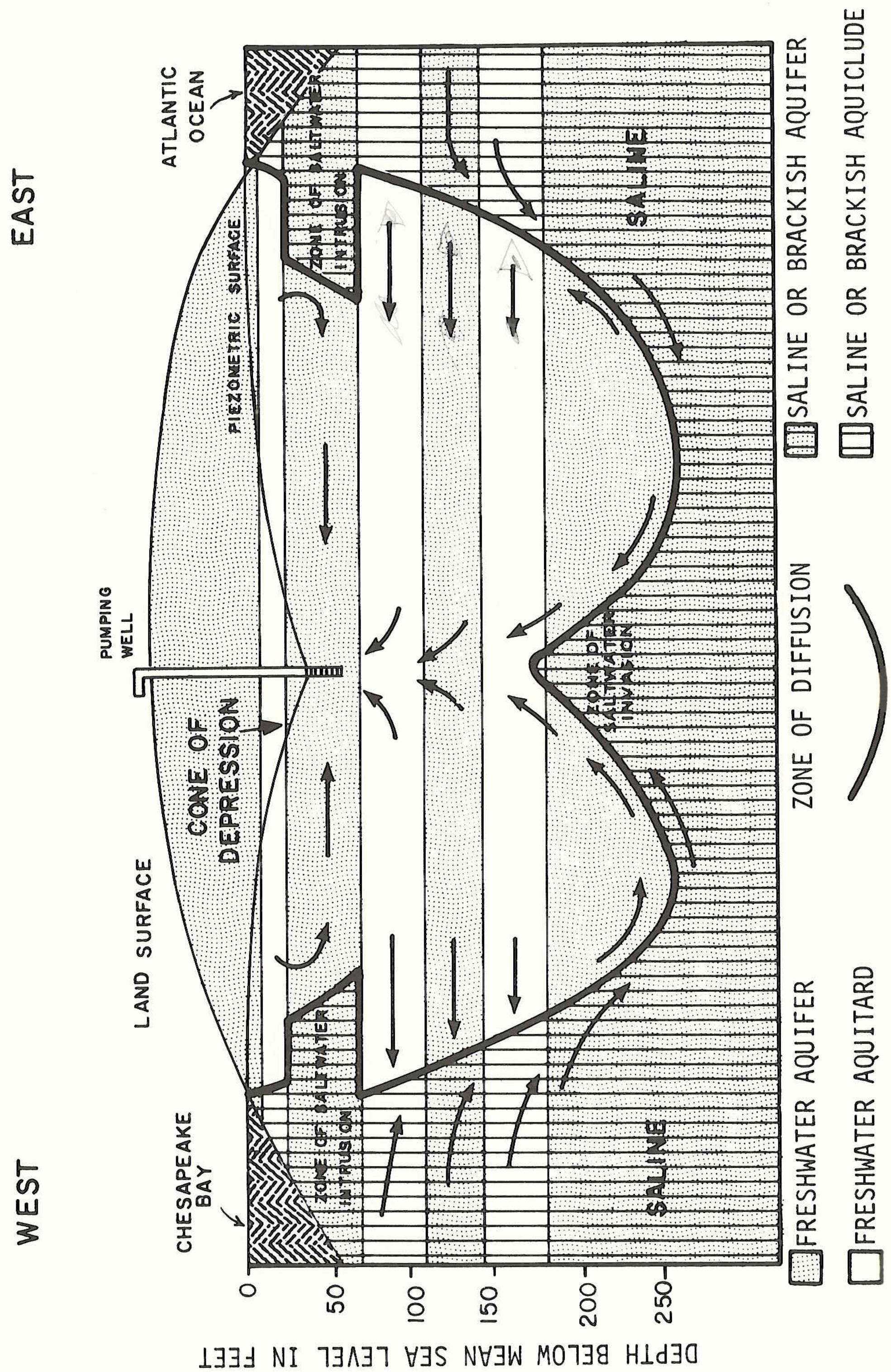
PLATE NO. 7

surrounding saline water into the freshwater aquifers. Localized heavy pumpage of the artesian aquifers on the Eastern Shore changes regional flow patterns by creating a cone of depression. This cone causes an artificial gradient, which increases the rate of vertical recharge to the artesian aquifers within the cone. (Division of Water Resources, 1972)

A direct hydrologic correlation in respect to saline migration exists between the lateral extensions and the vertex of a cone of depression. Should the lateral portion of this cone extend into a saline body, saline migration is induced along this gradient since the original freshwater-saltwater interface is no longer in equilibrium at that point (Figure 8). Furthermore, as freshwater is drawn from the aquifer, the pressure (head) on it is lowered, thus disturbing the previous equilibrium with the underlying saltwater, allowing saltwater to move upward to a point where a new interface can be established (See Groundwater Quality).

The recharge-discharge system for the Pre-Miocene aquifers on the Eastern Shore is in a large part related to the Pre-Miocene flow system of the mainland. Much of the recharge takes place west of Chesapeake Bay where the Pre-Miocene aquifers are at or near the surface. Flow is directed from the mainland downdip and eastward toward the Eastern Shore. The freshwater aquifer discharges into the saline portion of the aquifer which begins below middle Chesapeake Bay and extends oceanward (Back, 1966).

HYPOTHETICAL SALINE WATER MOVEMENT DUE TO EXCESSIVE PUMPING (MODIFIED FROM DIVISION OF WATER RESOURCES, 1972)



Source: Virginia State Water Control Board

PLATE NO. 8

CHAPTER III

GROUNDWATER QUALITY

General Conditions

The general differences in natural groundwater quality among the aquifers on the Eastern Shore are dependent on two major changes; chemical changes which occur as groundwater moves through the groundwater reservoir from recharge areas to discharge areas and those which occur when freshwater is mixed with saline water at the freshwater-saltwater interface (Plate 7). The low concentration of dissolved solids, hardness, and bicarbonate ions generally found within the Pleistocene aquifer is a consequence of the low mineral content of precipitation which first percolates through the Pleistocene aquifer and dissolves a small quantity of minerals during its short path of travel within the Pleistocene aquifer (Table 4).

As groundwater continues to move farther from recharge areas, more minerals are dissolved by the chemically unsaturated groundwater as evidenced by the increasing amount of dissolved solids and bicarbonate ions found in the Yorktown and St. Marys aquifers (Plate 7 and Table 4). However, within the deep St. Marys formation the freshwater-saline water interface is encountered. Higher chloride and low hardness concentrations are found more within the St. Marys formation than are found in the overlying Yorktown formation. This change observed in the St. Marys formation is caused by the natural softening process which occurs when freshwater and saltwater are mixed at the freshwater-saltwater interface.

The unusual composition of the groundwater found within the deeper Pre-Miocene aquifers on Tangier Island indicates that the aquifer is recharged from the Virginia mainland (Sinnott and Tibbitts (1968) and Table 4). The high total dissolved solids concentration is attained as minerals are dissolved along the length of the flow path. Low hardness and high bicarbonate con-

Table 4.--Average parts-per-million of dissolved solids, hardness, bicarbonate, chloride and iron

Formation	Dissolved Solids		Hardness		Bicarbonate		Chloride		Iron	
	Average	Sample Size	Average	Sample Size	Average	Sample Size	Average	Sample Size	Average	Sample Size
Pleistocene	153.4	10	79.35	63	67.54	35	27.03	60	2.08	27
Yorktown	180.8	15	112.35	125	132.78	49	33.06	85	0.56	41
St. Marys	210.25	8	105.36	44	187.50	36	107.62	41	0.15	12
Pre-Miocene Tangier Island	857	1	11.67	3	531.50	4	58.37	4	0.24	3

centrations are present on Tangier Island because the freshwater-saltwater interface within the Pre-Miocene aquifers is in close proximity to the Island (Plate 9).

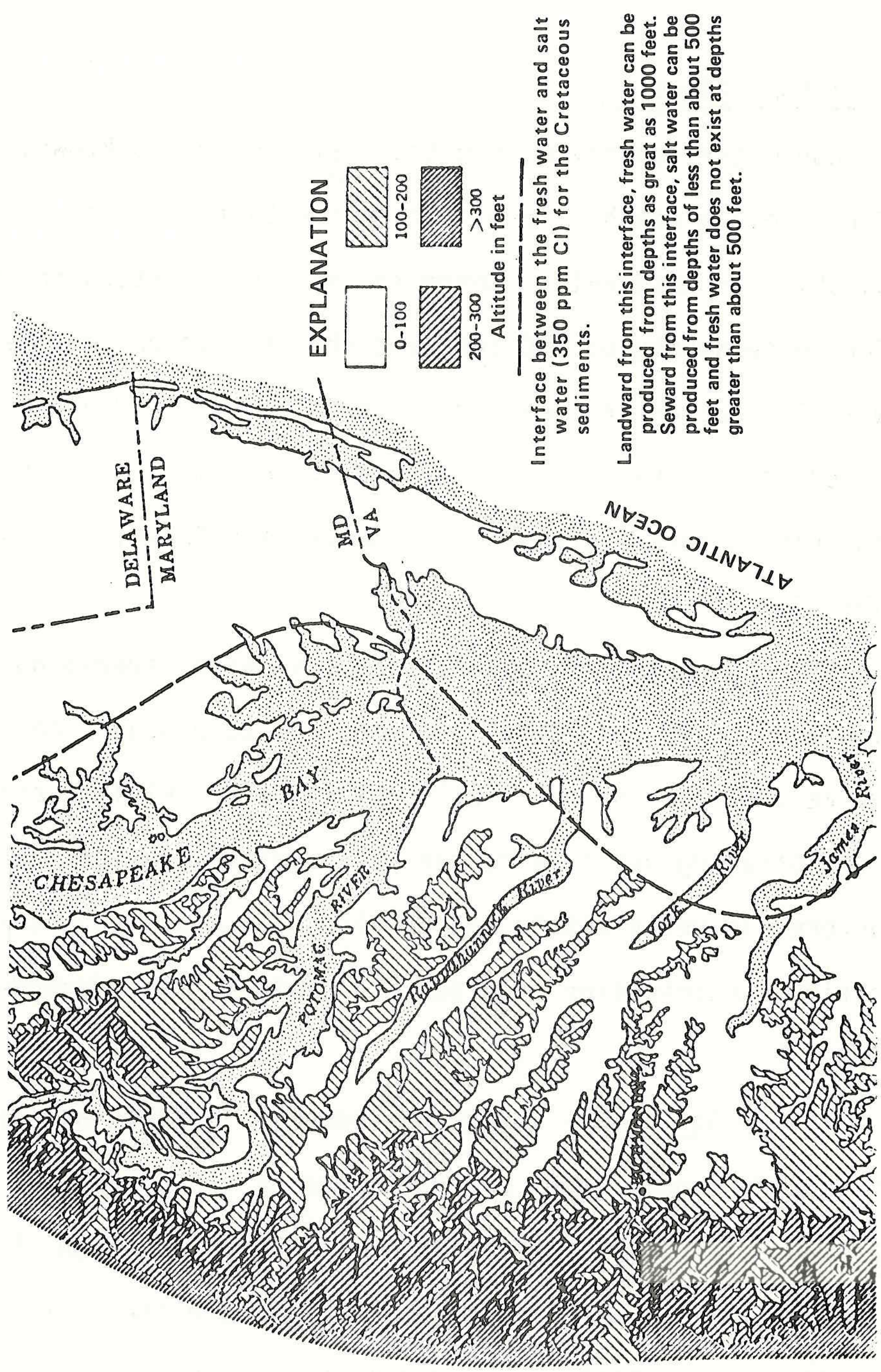
Specific Conditions

Groundwater quality within the Pleistocene, Yorktown, and St. Marys aquifers above a depth of 300 feet on the Eastern Shore mainland generally is suitable for most water uses on the Virginia Eastern Shore. The St. Marys aquifer below depths of 300 feet and the Pre-Miocene aquifers which occur below 1,100 feet on the mainland tend to be highly mineralized. Average dissolved solids, hardness, bicarbonate, chloride, and iron concentrations for the Pleistocene, Yorktown, St. Marys, and Pre-Miocene aquifers are given in Table 4.

Pleistocene Aquifer - Iron content is high, averaging 2.1 parts-per-million and varies considerably from place to place. The water may be corrosive due to a low pH. Wells utilizing the Pleistocene aquifer generally require softening units to remove iron. High chlorides may be encountered in wells within the tidal zone. Locally, nitrates may be high indicating contamination from surface drainage (See Groundwater Contamination Problems).

Yorktown Aquifers - The water from the Yorktown aquifer is generally of the hard bicarbonate type. Hardness ranges from 70 to 130 parts-per-million and averages 112 ppm. Locally, iron may be high. High chlorides may be encountered near or within the tidal zone where there is a hydraulic continuity with saline or brackish surface water (See Groundwater Problems).

St. Marys Aquifer - The water from the St. Marys aquifers is, on the average, softer and lower in iron than water of the overlying Yorktown aquifers



MAP SHOWING THE RELATIONSHIP OF TOPOGRAPHY TO LANDWARD EXTENT OF SALTWATER AND FRESHWATER INTERFACE IN THE CRETACEOUS DEPOSITS. (MODIFIED FROM BACK, 1966)

Source: Virginia State Water Control Board

PLATE NO. 9

The lower St. Marys aquifers are generally highly mineralized (see 165-57, Appendix C, and Groundwater Problems).

<u>Pre-Miocene Aquifers</u> - The water from the Pre-Miocene aquifers on Tangier Island is generally a soft bicarbonate type. Total dissolved solids are high, in the range of 857 ppm. Only limited water quality data is available for the Pre-Miocene aquifers of the mainland. A 1,001 foot test well at Cobb Island was abandoned because it produced brackish water (Sinnott and Tibbitts, 1968). A 1,000 foot test well on Chincoteague Island in Northeastern Accomack County indicated the presence of brackish water (Leroy Jester, personal communication).[1] From the limited data available it appears that water from the Pre-Miocene aquifers on the mainland would generally be brackish and of very limited usefulness. Back (1966) indicates that the reason the Pre-Miocene aquifers on the Eastern Shore mainland will tend to be more mineralized is that the freshwater-saltwater interface is located west of the Eastern Shore Peninsula running near Tangier Island (Plate 9).

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[1] Leroy Jester, Water Superintendent, Town of Chincoteague

CHAPTER IV

GROUNDWATER PROBLEMS

Water Level Declines

Groundwater levels on the Eastern Shore have been relatively constant since the 1900's, except in specific localities where heavy groundwater withdrawals from the artesian aquifers have caused cones of depression to develop which have extended as far as a mile from pumping centers. Static water levels in Sanford (1913), Sinnott and Tibbitts (1968), Division of Water Resources (1972), and Appendix A indicate that natural water table and artesian groundwater levels have been above sea level and generally conform to the natural flow patterns discussed in the previous section. Local static water level irregularities are attributed to inaccuracies in well elevation data and water level measurement during pumping, as well as tidal or seasonal variations, and possibly semi-artesian conditions (see Groundwater Movement).

The two largest cones of depression on the Eastern Shore began to develop in the late 1960's and early 1970's when the largest water users, Holly Farms Poultry Products and Perdue, Inc. began to withdraw approximately 0.8 and 1.4 mgd, respectively. The water level declines caused by the withdrawals of these two large water users were first noted when artesian wells within the cones of depression would not operate because of the lower water level. Water well contractors serviced these wells so that water could be obtained at these lower levels (Blake and Company, Boggs Water and Sewage and Bundick Well and Pump Service, personal communication).[2]

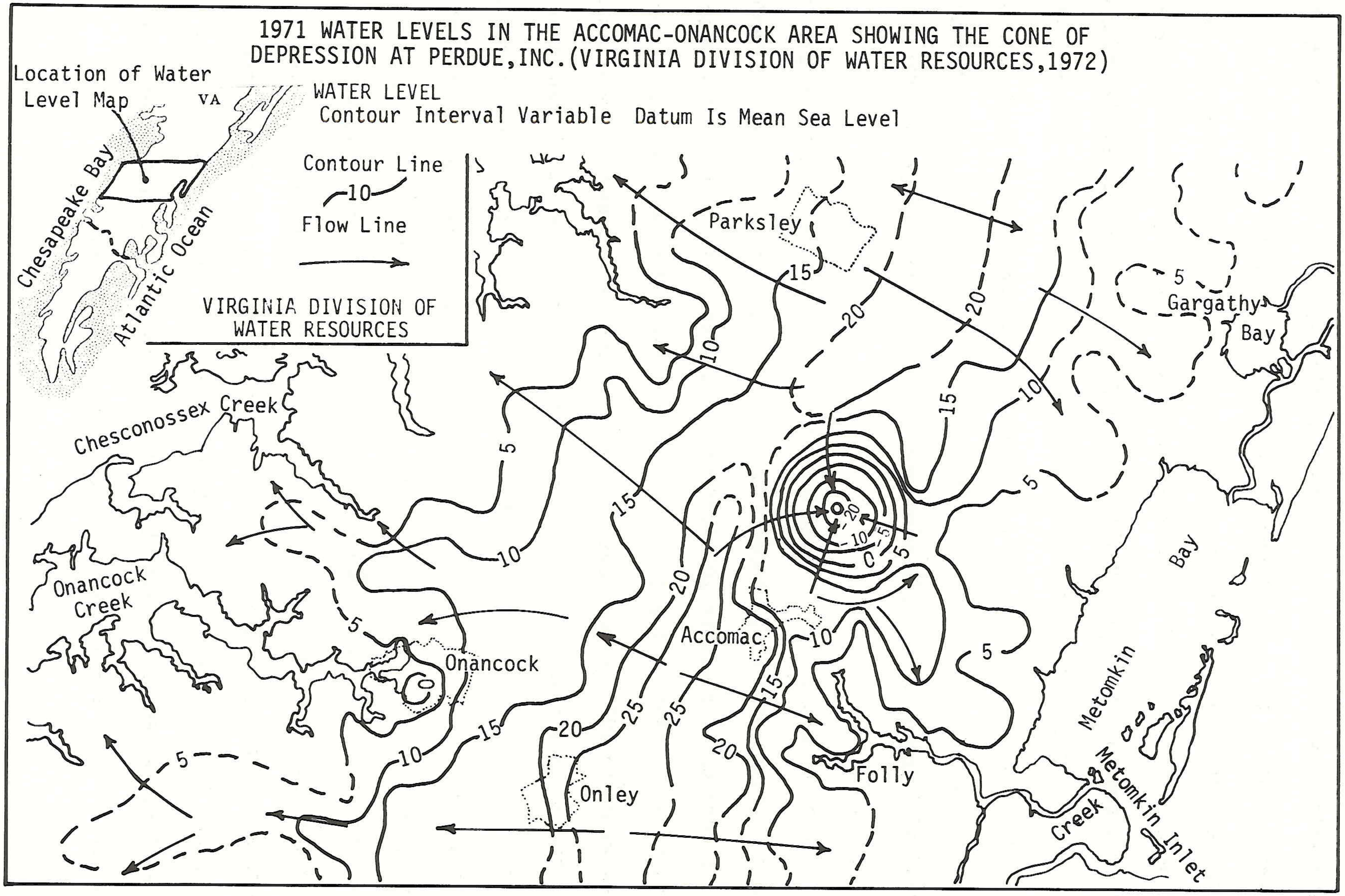
The largest cone of depression on the Eastern Shore encompasses the Perdue, Inc. well field in Accomac. The cone of depression is approximately two miles in diameter, encompassing a three and one-half square mile area,

[2] Blake and Company, Boggs Water and Sewage and Bundick Well and Pump Service, Water Well Contractors on the Virginia Eastern Shore.

with water level declines of 100 feet at the center of the cone (Plate 10). Water levels in the pumping wells fluctuate in response to changes in daily pumpage. The static water levels during the weekend when there is no water withdrawal fluctuates from 83 to 55 feet below the land surface during high and low demand months, respectively (Plate 11). At this time, the cone of depression appears to have stabilized or come to equilibrium for the 1973-74 average withdrawals of 2.1 mgd. In the future, however, the cone will probably expand as withdrawals increase. This trend of expansion is supported by the trend of increasing Perdue's withdrawals since pumpage began in 1970 (Appendix F).

A major problem associated with the cone of depression at Perdue is the previously mentioned competition between water users. Three of Perdue's wells were drilled within 200 feet of a residential section which already had private wells tapping the same artesian aquifer. When Perdue began to withdraw water in 1970, water levels in many of the wells tapping the artesian aquifer decreased until water could not be reached. Some well owners had to have only the jet setting of their jet pump lowered to obtain water at lower depths. Other well owners burned out their jet pumps before the jet setting was lowered and thus were forced to replace the entire costly pump.

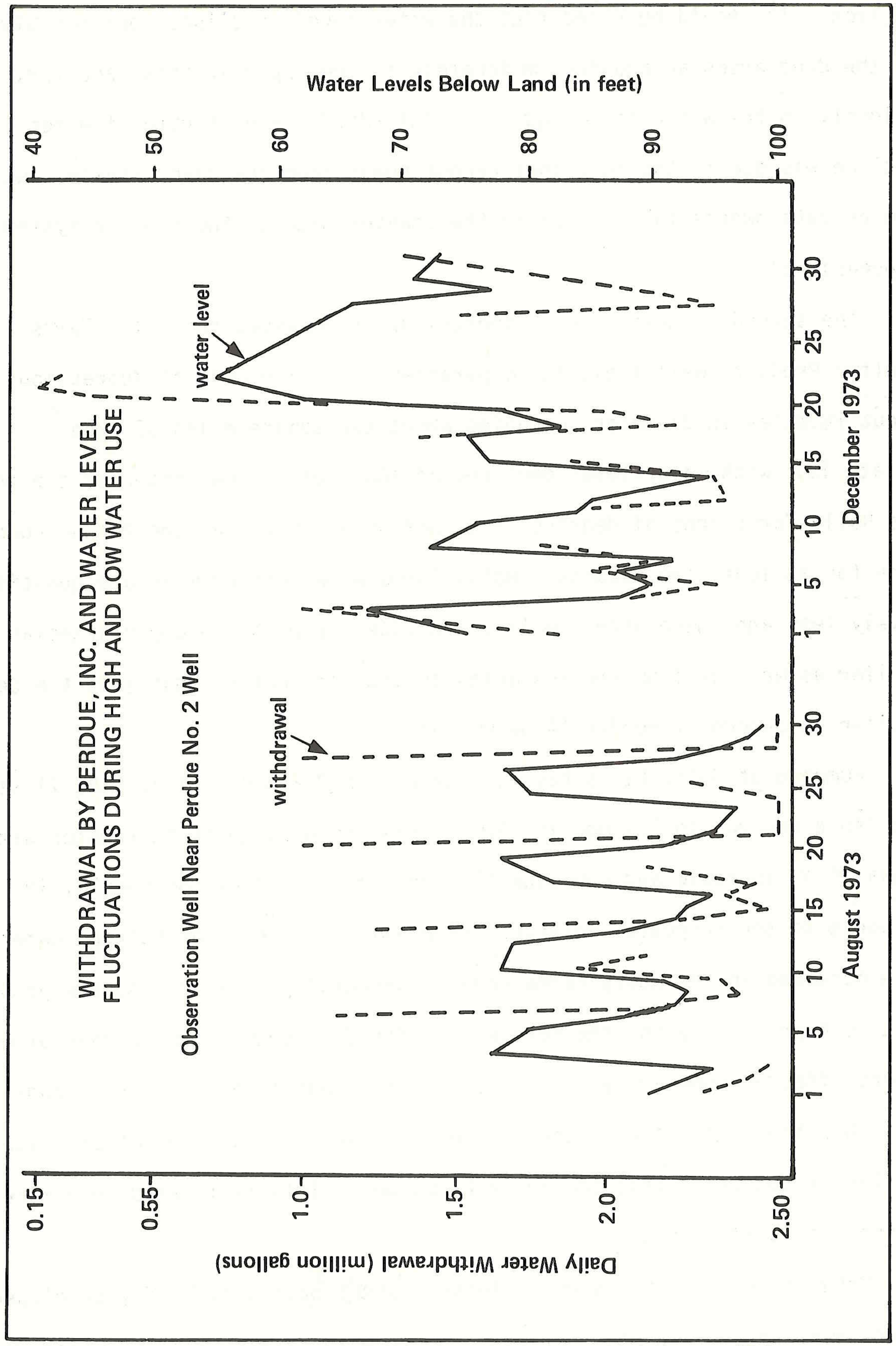
At the private well owners adjacent to Perdue's wells, water levels were too low to be reached with a jet pump. In the process of attempting to obtain water with such pumps, the owner often paid for one or more jet pumps in addition to a jet setting. In order to obtain water, the owner hired water well contractors to drill new wells in the water table aquifer and to install a water softener because the water was high



1971 WATER LEVELS IN THE ACCOMAC-ONANCOCK AREA SHOWING THE CONE OF DEPRESSION AT PERDUE, INC. (VIRGINIA DIVISION OF WATER RESOURCES, 1972)

Source: Virginia State Water Control Board

PLATE NO. 10



Source: Virginia State Water Control Board

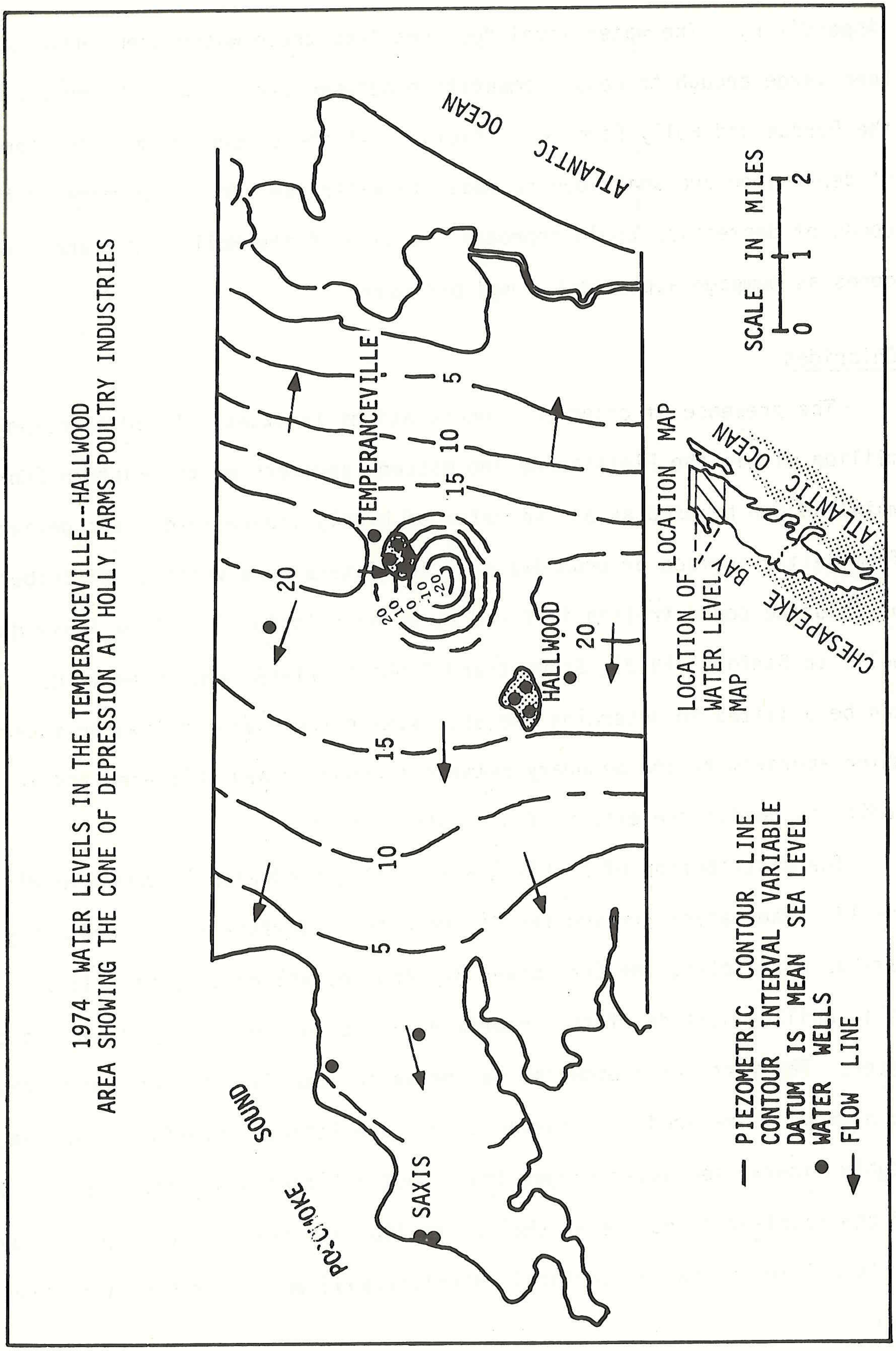
PLATE NO. 11

in iron. It should be noted that the water levels declined considerably in the deep artesian aquifer, moderately in the upper artesian aquifer, and slightly in the water table aquifer. This difference in rate of water level decline was due to the fact that Perdue pumps from the deep artesian aquifer. The private owners fully financed the changes made to their water systems (Appendix E).

The second largest cone of depression encompasses the Holly Farms Poultry Products well field in Temperanceville. The cone of depression is about 1½ miles in diameter, occupies about two square miles of area (Plate 12) with water level declines of 100 feet in the center of the cone. The Holly Farms cone of depression is not as extensive as the Perdue Foods cone for at least two reasons: Holly Farms water withdrawals are quantitatively less and these withdrawals are divided between the upper artesian aquifer as well as from the low artesian aquifer, rather than just the deeper aquifer as pumped by Perdue (Appendix A).

Pumpage at Holly Farms has increased from 0.8 mgd in 1968 (the first available record) to 1.2 mgd in 1974. This trend suggests that water withdrawal may increase and subsequently the cone of depression should, in response to the increase, enlarge. Problems of competition between water users have occurred in the Holly Farms cone of depression similarly to the problems discussed previously for the Perdue well field. However, the number of well owners affected monetarily by the Holly Farms cone of depression is considerably less than those affected by the Perdue Foods well field. The major reason for the lesser number is that the Holly Farms well field is located in a more sparsely populated area.

Other cones of depression of lesser extent have undoubtedly developed in Accomack and Northampton Counties due to withdrawals of other water users



Source: Virginia State Water Control Board

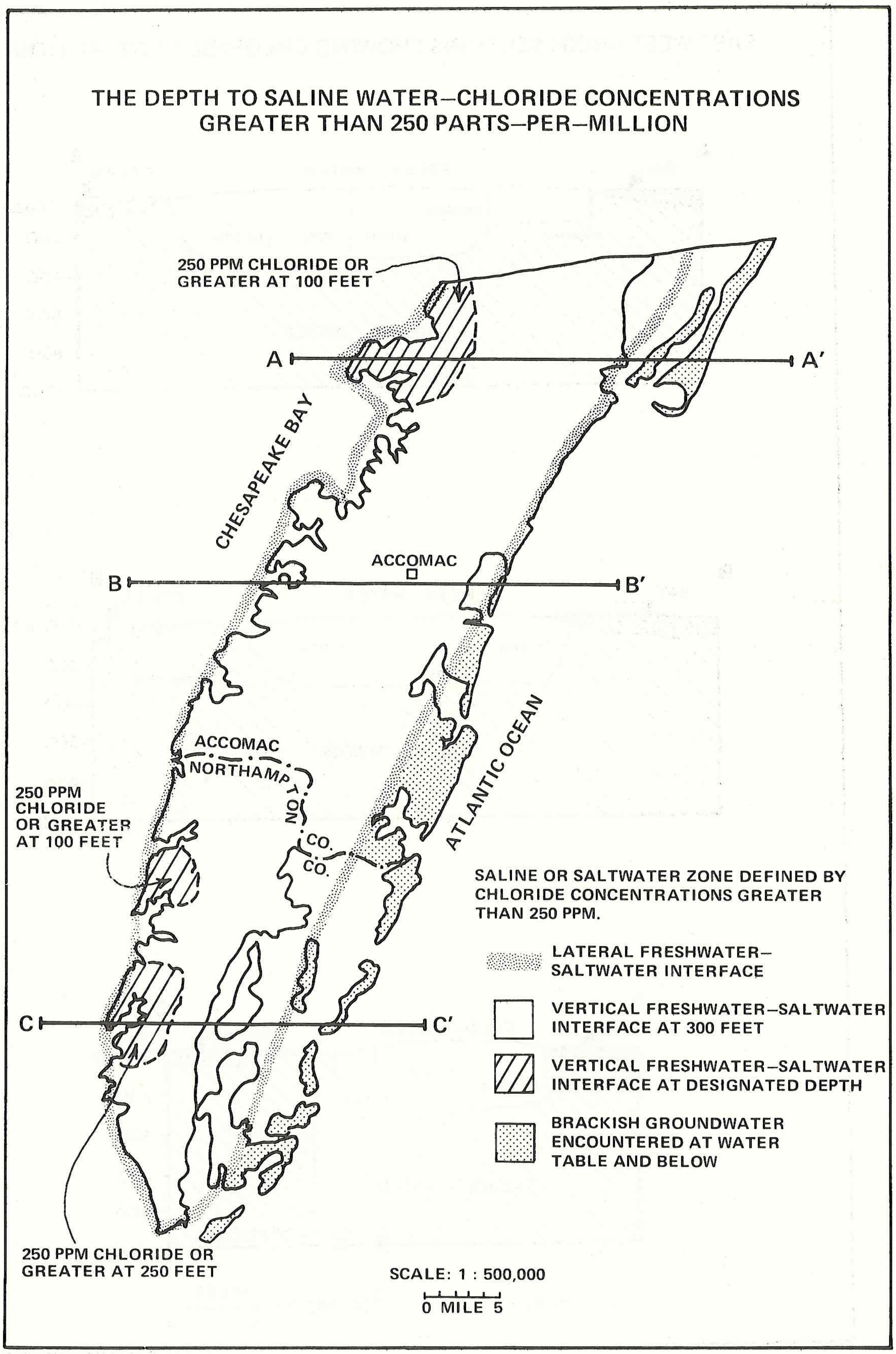
PLATE NO. 12

(Appendix F). The water level declines from these water users have not been large enough to cause competition between user as was observed within the Perdue and Holly Farms well fields. At the present time these cones of depression are small due to moderate water use but one or more of these cones of depression could approach the size of the Holly Farms and Perdue cones as pumpage approaches 1 mgd per user.

Chlorides

The presence of chloride concentrations in excess of 250 parts-per-million within the Pleistocene and Miocene aquifers on the Eastern Shore mainland can be used as an indicator of highly mineralized water derived from saline surface or groundwater. The lateral and vertical distribution of chloride concentration is found by using chloride data from individual wells in Sanford (1913), Sinnott and Tibbitts (1968) and Appendix D. This information can be utilized to determine the approximate freshwater-saltwater interfaces which approximate the boundary between freshwater and saltwater and in addition, depict the extent of saltwater intrusion.

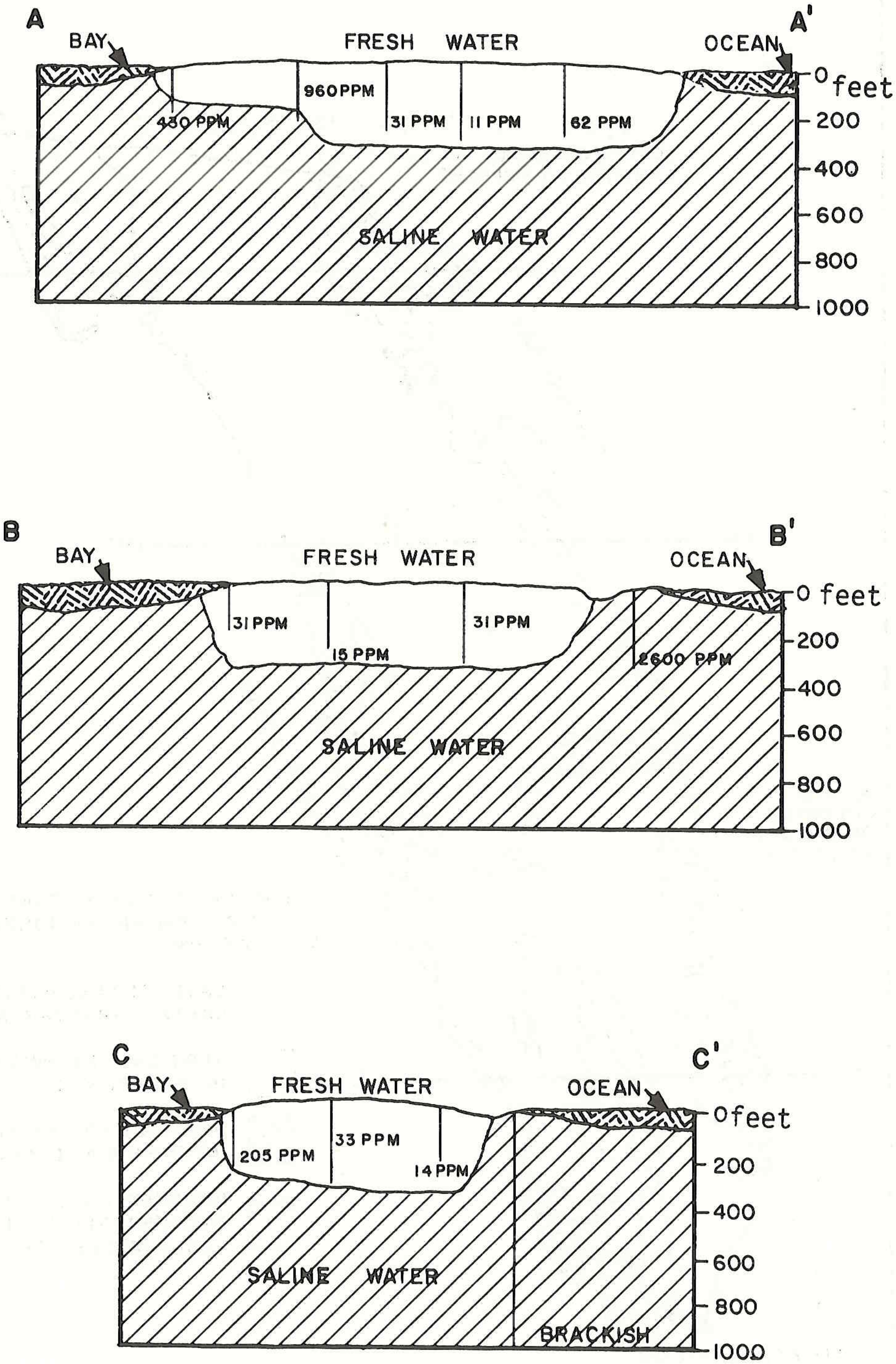
The distribution of highly mineralized groundwater is shown in Plates 13 and 14. The lateral freshwater-saline water interface is located along the marshes paralleling the Chesapeake Bay and the Atlantic Ocean (Plate 13). Wells drilled outside of the interface will encounter highly mineralized water. The vertical freshwater-saline water interface is defined as the depth to highly mineralized groundwater within the lateral interface. The depth of highly mineralized water ranges from about 300 feet along the central ridge of the mainland to depths as shallow as 100 feet near the Chesapeake Bay. Wells drilled below the vertical interface will encounter highly mineralized water.



Source: Virginia State Water Control Board

PLATE NO. 13

EAST-WEST CROSS-SECTIONS SHOWING CHLORIDE DISTRIBUTION



HORIZONTAL SCALE 1:500,000

MILES
0 5

Source: Virginia State Water Control Board

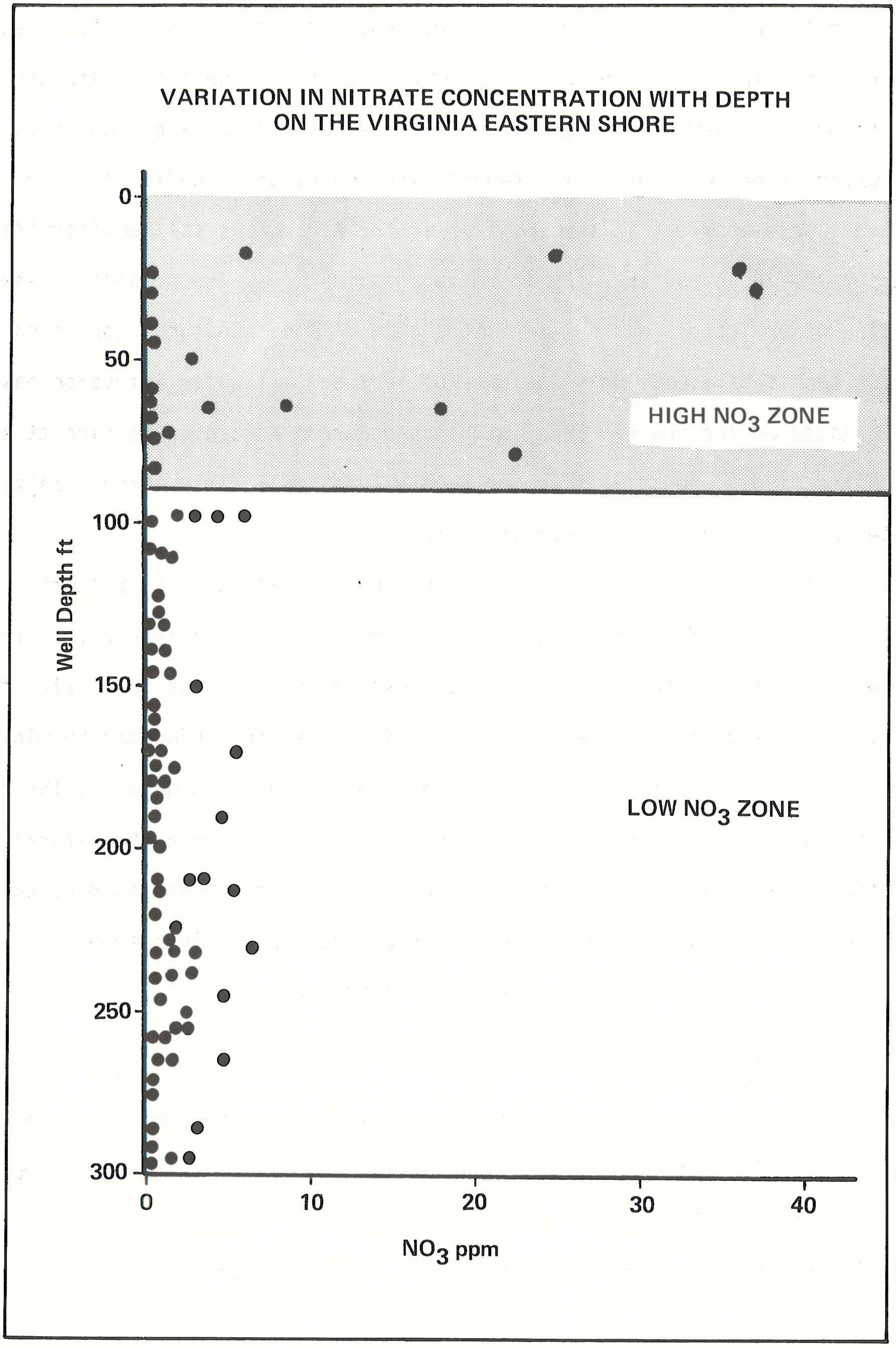
PLATE NO. 14

At the present time there is no evidence of significant regional saltwater intrusion. The Environmental Protection Agency (1973) defines saltwater intrusion as the encroachment of saline water into previously freshwater aquifers, induced by water withdrawals or other changes altering natural conditions. No changes were observed in the position of the freshwater-saline water interface during the 70 years for which there is chloride data. The present freshwater-saline water interface shown in Plates 13 and 14 is a natural condition which has stabilized. Only one case of vertical saltwater intrusion has been noted on the Shore. This intrusion occurred according to Sinnott and Tibbitts (1968) when a well in the Exmore Foods well field turned "salty" after a period of time and was abandoned.

Saltwater intrusion will occur whenever the natural flow pattern (Plate 7) is modified to the extent that the flow of saltwater enters freshwater aquifers (Plate 8). Cones of depression which extend into saltwater bodies will induce saltwater intrusion. Saltwater intrusion can be minimized by locating well fields with significant cones of depression along the central ridge. Such a location would maximize the distance between the lateral freshwater-saltwater interface. A computer or analog model could be used to predict situations when saltwater intrusion would occur in response to present and future water withdrawals (Desai and Contractor, 1975).

Groundwater Contamination

The presence of high nitrate concentrations in groundwater on the Eastern Shore is an indication of groundwater contamination attributed to nitrogen rich deposits in buried soil zones. High nitrates are generally found in shallow groundwater within 90 feet of the surface (Plate 15). This contaminated



Source: Virginia State Water Control Board

PLATE NO. 15

zone is within the Pleistocene aquifer which is under water table conditions and is therefore susceptible to surface contamination. Although the specific sources of contamination have not been identified, high nitrates generally indicate such sources of contamination as septic tanks, feedlots, and fertilizers (Walker, 1968). One well used by the Town of Parksley (100-1, Appendix B) is 140 feet deep and shows fluctuations in sulfates and chlorides in addition to nitrates. The high sulfates and chlorides in this case are attributed to outside pollutants, rather than to any natural causes. Other contaminants, which are not commonly analyzed, may also be in the groundwater.

The preceding indication of groundwater contamination may be important to further groundwater development on the Eastern Shore. The present degree and sources of contamination within the shallow and artesian aquifers should be defined. In the future, groundwater contamination will almost certainly increase, if not properly managed, because the quantity of man-made wastes and other material--i.e. domestic sewage, solid wastes, fertilizers, insecticides, and other chemical wastes will increase proportionately with population and industrial development. In addition, increased pumpage will increase vertical recharge and thus may induce the vertical flow of contaminants where wastes are located within large cones of depression. Once the contaminants are induced vertically into the aquifer, they will flow laterally and may contaminate nearby pumping wells.

It is important to place future waste disposal sites at locations which would minimize contamination. The objective would be to minimize the possible flow path of contaminants from the surface to discharge areas in the Bay, Ocean, or saline aquifers. The best sites would, of necessity, have to be located away from major recharge areas on the central plateau, but closer to discharge areas situated near the Bay and the Atlantic Ocean (Sendlein and Palmquist, 1975). However, the waste disposal site must be located far enough from surface water bodies to prevent the discharge of contaminated groundwater into the surface water bodies. Further study is needed to determine the optimum distance from the Bay or Ocean which would minimize both groundwater and surface water contamination.

It should be inferred from the preceding discussions concerning the distribution of mineralized water, general contamination of groundwater, and saltwater intrusion references, that the future supply of available water is dependent on solutions to these water quality problems. In other words, estimates of water supply availability, based solely on quantity figures such as recharge are not only inaccurate, but misleading as well. Saltwater intrusion as well as general groundwater contamination must be prevented or extremely restricted in order for the Virginia Eastern Shore's future water demands to be assured.

CHAPTER V

AVAILABLILITY OF WATER

Present Use

Present and future water demand on the Eastern Shore were estimated by the Virginia Division of State Planning and Community Affairs (1972). The total water demand for the year 1960-70 period was estimated from limited data to be 4.4 billion gallons per year. It is useful to break this figure down into the various demands which are:

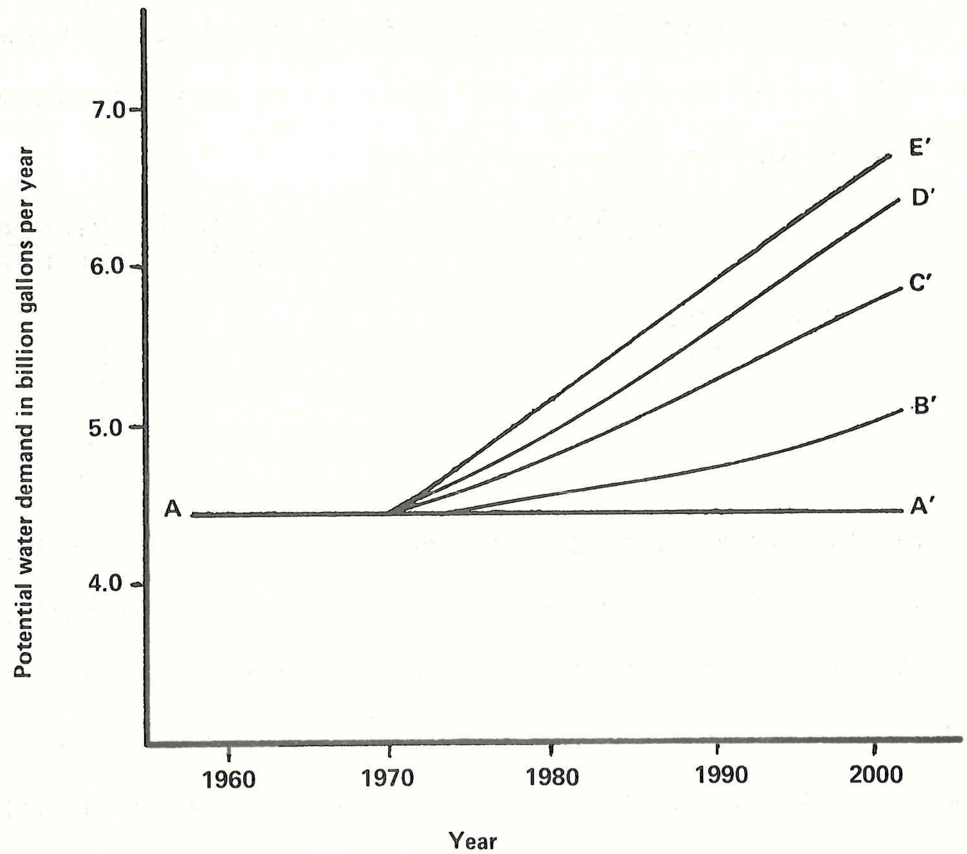
Source of Demand	Quantity Demanded in billion gallons per year
Agri-business sector uses	
Irrigation water	1.35
Agricultural Food Processing	1.12
Domestic and Public Uses	1.58
Other Uses	.37
Total	4.42

The irrigation demand was estimated by assuming that 4.5 inches are applied to a typical irrigated acre and that 11,094 acres are irrigated. The agricultural food processing demand on the Shore including poultry, vegetables, and fruit products, was estimated from Economic Data Summaries. The domestic and public demand was obtained by assuming 100 gallons per capita as the average daily water consumption and using the 1970 population figure of 43,445. Other demand was a catch-all for those part-time food processors in the agri-business and seafood sectors.

Future Needs

Four future demand curves were estimated based on four separate sets of demand assumptions (Plate 16). If there is no increase in demand, future demand will follow curve A-A'. The domestic and service related demand is extremely uncertain because of the difficulty in estimating the Eastern Shore population. If other demands remained constant and the population increased

WATER DEMAND FOR THE EASTERN SHORE OF VIRGINIA FROM 1970 TO 2000 (MODIFIED FROM VIRGINIA DIVISION OF STATE PLANNING AND COMMUNITY AFFAIRS, 1972)



Curve A-A': Water demand assuming no change in present demand.

Curve A-B': Water demand assuming no change except for a 1% yearly increase in population.

Curve A-C': Water demand assuming no change except for a 100% increase in irrigation water demand between 1970 and 2000.

Curve A-D': Water demand assuming no change except for a 100% increase in irrigation water demand and a 1% yearly increase in population.

Curve A-E': Water demand assuming no change except for a 100% increase in irrigation water demand and a sudden increase of 5000 persons in population by 1985 due to offshore oil and gas exploration and development.

Source: Virginia State Water Control Board

PLATE NO. 16

1% for the water demand would follow curve A-B'. There are many factors which determine the irrigation demand including weather (volume and distribution of rain, temperature, and wind), irrigation costs (including water costs), land market (profit market and crops grown). According to Virginia Division of State Planning and Community Affairs (1972), water demand will not increase significantly before the year 2000, except for irrigation water demand which may double in future years (Curve A-C'). If irrigation demand doubles by the year 2000 and population were to increase 1% per year by that date, then demand could possibly be 6.3 billion gallons in the year 2000 (Curve A-D').

The Virginia Division of State Planning and Community Affairs (1972) did not consider the effect of offshore oil and gas development on future water demand on the Eastern Shore. The Virginia Outer Continental Shelf Advisory Committee (1974) estimates that by 1985 outer continental shelf development on the Eastern Shore will require about 0.6 mgd of water. Development includes a proposed Brown and Root offshore drilling platform fabricating plant, two gas processing plants and an increase in population of 6,000 persons by 1985. The water demand assuming that offshore development will only increase slightly after 1985 and that the other demands will follow curve A-D' (Plate 16), would generally follow curve A-E'. Demand may be above A-E' if offshore oil and gas development is extensive. On the other hand, a low degree of offshore oil and gas development and a smaller increase in irrigation than anticipated would mean that demand would roughly follow curve A-E'.

Future Potential Supply

It is important to predict the potential groundwater supply available

on the Eastern Shore in order to determine the availability of water for future development and the distribution of supply for adequate land use planning.

Inspection of present water use on the Eastern Shore indicates that water demand (Curve A-E', Plate 12) projected to the year 2000 will probably be satisfied by further groundwater development. However, if future development on the Shore is substantially greater than predicted by the Virginia Outer Continental Shelf Advisory Committee (1974), future water demand may not be as easily satisfied. Many problems discussed previously which affect the availability of groundwater for supply must be considered to arrive at reliable figures for future water supply on the Eastern Shore.

A computer model should be designed to evaluate physical and chemical parameters to determine the degree to which groundwater problems on the Eastern Shore, including water level declines, saltwater intrusion, and groundwater contamination, will limit future groundwater supply. Data including the area's extent, recharge, and physical characteristics of the aquifer should be used to model regional flow patterns and water levels within the Pleistocene, Yorktown and St. Marys aquifers. The effect of future withdrawals on water levels and regional flow pattern can be then evaluated and the optimum spacing of well fields on the Virginia Eastern Shore can then be made. Further refinement of the model would be necessary to evaluate water quality and density data so that saltwater intrusion may be predicted for future water withdrawals and water level conditions on the Eastern Shore as exemplified in Pinder (1970). Groundwater contamination data should also be entered into the model to estimate the aquifers or parts of which may be contaminated beyond use in the future. Only after an estimate of the effect of these three major problems can a complete assessment of future water supply on the Virginia Eastern Shore be made.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

From this study it is concluded that the following conditions exist on the Eastern Shore.

(1) Groundwater level declines--Artesian groundwater levels have declined excessively in sections of Accomack County within the cones of depression of Perdue, Inc. and Holly Farms Poultry Products. Groundwater levels in these areas may continue to decline as water withdrawals increase. No major groundwater level declines are occurring in Northampton County at the present time, but future withdrawals like those in Accomack County could create similar problems in Northampton County.

(2) Interference between users--The wells of Perdue, Inc. as well as those of Holly Farms Poultry Products in Accomack County have interfered with the wells of a number of adjacent private well owners.

(3) Saltwater Intrusion--There is no evidence of significant saltwater intrusion occurring on the Eastern Shore at the present time but increases in water withdrawals may create saltwater intrusion problems in the future.

(4) Groundwater Contamination--The Pleistocene aquifer on the Eastern Shore has been exposed to numerous pollutants and may be expected to become increasingly more polluted as future development proceeds. There is no evidence of significant groundwater contamination to the Yorktown and St. Marys aquifers at the present time but these aquifers may also be expected to become polluted as development proceeds.

Recommendations

(1) A computer model should be constructed to determine future water supply available on the Eastern Shore based on field data and data in this report. Specifically, the model should predict groundwater level declines, saltwater intrusion, and the present and future extent of groundwater contamination.

(2) A comprehensive and continuous program of basic data collection is necessary for an understanding of groundwater conditions and for the implementation of the computer model. The type of necessary data includes:

(a) basic data for aquifer description,

(b) basic data for hydrologic information, including pumping tests and a network of observation wells to monitor water levels including a continuous recording gage,

(c) groundwater quality data,

(d) data on water withdrawals for the major water users, and

(e) information on newly constructed wells and on abandonment of wells.

(3) Competition between large water users and private well owners may be minimized if the private owners change to a public system. Public type water supplies would be more efficient and economical in these areas of increasing competition. Also, the large water users should be encouraged to locate their well field away from a developed area.

(4) A periodic special chloride survey of wells along the Bay and Ocean adjacent to highly pumped areas can determine at what rate if any saltwater intrusion is occurring. It is important to sample wells of varying depth and especially those which are of equal depth to those within the major well fields. In addition, a program of exploratory drilling is necessary to

define the depth of high chlorides in the vicinity of the larger cones of depression. Geophysical logs should be collected for each well, and water samples should be collected for each specific aquifer. The same test hole may be completed as an observation well in which to monitor water levels and water quality.

(5) A survey of wells high in nitrates should be made to determine the source and extent of contamination. Useful data may be obtained by chemically monitoring landfills, holding ponds, fertilized fields, etc. at various topographic positions to determine the vertical and horizontal extent of contaminated groundwater. Data obtained can be used to establish general criteria for waste disposal on the Eastern Shore.

(6) Increased development of the Pleistocene water table aquifer for irrigation and other uses which do not require high quality water should be encouraged in order to avoid excessive drawdowns and possible dewatering of the underlying artesian aquifers.

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Definitions

Aquiclude	- A formation of relatively low permeability that overlies or underlies an artesian aquifer and confines water in the aquifer under pressure.
Aquifer	- A water-bearing formation, group of formations, or part of a formation that will yield groundwater in useful quantities.
Aquitard	- A formation that partially restricts groundwater flow.
Artesian aquifer	- A confined aquifer in which groundwater rises in a well above the point at which it is found in the aquifer.
Bicarbonates (Metal + HCO_3 e.g. Na HCO_3)	- Can raise the pH to a high concentration which may be corrosive.
Capillary fringe	- The zone of partial or complete saturation directly above the water table in which water is held in the pore spaces by capillarity.
Chlorides (Cl^-)	- Are indicative of concentrations of salt water concentrations above 250 milligrams per liter (mg/l) are detectable by taste.
Cone of depression	- A conelike depression of water table or of the piezometric surface that is found in the vicinity of a well by pumping. The surface area included in the cone is known as the area of influence of the well.
Confined water	- Water under artesian pressure. Water that is not confined is said to be under water table conditions.
Confining bed	- A bed which overlies or underlies an aquifer and which, because of low permeability relative to the aquifer, prevents or impedes upward or downward loss of water and pressure. An aquiclude.
Dissolved Solids	- Generally noticeable in concentrations greater than 500 mg/l.
Drawdown	- The depression or decline of the water level in a pumped well or in nearby wells caused by pumping. It is the vertical distance between the static and the pumping levels of the well.

Evapotranspiration	- The combined discharge of water to the air by direct evaporation and plant transpiration.
Flowing well	- A well having sufficient artesian pressure head to discharge water above the land surface.
Groundwater	- Water beneath land surface in the zone of saturation and below the water table.
Hardness	- Quality of water that prevents lathering because of calcium and magnesium salts which form insoluble soaps.
Hydraulic gradient	- The gradient or slope of the water table of piezometric surface, in the direction of the greatest slope generally expressed in feet per mile.
Hydrogeology	- The science of the natural laws that control occurrence and movement of groundwater. Geology as affected by hydrology.
Hydrology	- The science that relates to water movements and physical characteristics.
Igneous rocks (Basement Rock)	- Rocks formed by the cooling and crystallization of molten or partly molten material.
Infiltration	- The flow or movement of water into the surface soil and rocks.
Interstices	- The openings or pore spaces in a soil or rock formation. In an aquifer, they are filled with water.
Lithology	- The large scale physical characteristics of rocks/sediments.
Losing stream	- A stream losing water to groundwater storage (formerly termed "influent stream").
Metamorphic rocks	- Rocks altered from preexisting rocks by changes in temperature, pressure, and chemical environment.
Nitrates (NO_3)	- A salt or ester of nitrous acid (concentrations greater than 45 parts per million (ppm) can be toxic.
Nonflowing artesian well	- An artesian well in which the head is not sufficient to raise water to the land surface at the well site.

pH	-	The negative logarithm of the Hydrogen Ion activity--measured 1 through 14 with 7 being neutral, 1 being most indicative of acidity and 14 most indicative of alkalinity.
Paleontology	-	The study of fossil animal and plant remains to determine past environments.
Percolation	-	Movement under hydrostatic pressure of water through the interstices of rocks or soils, except movement through large openings such as solution channels.
Permeability	-	The ability of a rock to transmit water per unit of cross-section.
Piezometric surface	-	An imaginary surface that everywhere coincides with the hydrostatic head of water in an artesian aquifer.
Porosity	-	The ratio of the volume of the openings in a rock to the total volume of the rock.
Pumping level	-	The relative elevation of the water surface in a well during pumping.
Recharge	-	The addition of water to an aquifer by natural infiltration or artificial means. Injection of water into an aquifer through wells is one form of artificial recharge.
Recovery	-	The residual drawdown after pumping has stopped.
Saltwater intrusion	-	The phenomenon occurring when a body of saltwater, because of its greater density, invades a body of freshwater. This may be caused by a loss of pressure in the freshwater.
Sedimentary rocks	-	Usually stratified formations consisting of products of weathering by action of water, wind, ice, etc.
Static water level	-	The level of water in a non-pumping or non-flowing well.
Stratigraphy	-	The relationship of the formation composition, sequence and correlation of layered rocks on sediments.
Storage Coefficient	-	Volume of water contained in an aquifer which is related to porosity. Expressed as an absolute value normally from 0.00001 to 0.001 for artesian aquifers and from 0.01 to 0.35 for water table conditions.

Transmissivity	- The capacity of an aquifer to transmit water in gallons per unit of time per section 1 foot wide by aquifer thickness. Expressed as gallons per day per foot (gpd/ft) normally ranging from 1000 to 1,000,000 gpd/ft.
Unconfined aquifer	- Water not under artesian pressure. Generally applied to denote water below the water table.
Water table	- The surface of unconfined groundwater which is determined by gravity.
Water-table aquifer	- An aquifer which is not confined above, in which the water level in a well indicates the water table.
Zone of aeration	- The zone in which the open spaces in soil or in a rock formation contain air and water.
Zone of saturation	- The zone in which the open spaces in the rocks are completely filled with water.

APPENDIX A

Well Characteristics in the Major Well Fields

The following tables contain data on the well characteristics for the three major well fields on the Eastern Shore in recent years, including Holly Farms Poultry Industries in Temperanceville, Perdue, Inc. located in Accomac, and Exmore Foods in Exmore. The data was obtained from water well completion reports and interviews with plant operators. The data listed in Appendix A include:

State Water Control Board Well Number
Owner's Number
Screen Depth or Total Depth
Formation Name
Well Casing Diameter (in)
Test yield (gpm)
Drawdown (ft)
Specific Capacity (gpm/ft)
Operational yield (gpm)
Approximate transmissivity (gpd/ft)

WELL CHARACTERISTICS IN THE HOLLY FARMS POULTRY INDUSTRIES WELL FIELD, TEMPERANCEVILLE

SWCB Number 100-	Owner's Number	Screen Depth	Geologic Formation	Diameter (in)	Test Yield (gpm)	Drawdown (ft)	Specific Capacity (gpm/ft)	Operational Yield (gpm)	Approximate * Transmissivity (gpd/ft)
12	#1	134-149 150-173 205-215	Yorktown St. Marys	8	254	65	3.9 -12 hr	100	8,000
11	#2	138-146 157-171 200-212	Yorktown St. Marys	8	250	89	2.8 -5 hr	100	7,000
10	#3	138-146 158-172 200-212	Yorktown St. Marys	8	167	42	4.0 -7 hr	100	8,000
9	#4	132-140 156-170 196-208	Yorktown St. Marys	8	195	19	10.2 -8 hr	100	20,000
196	#5	130-138 152-166 196-204 214-222 226-234 270-285	Yorktown St. Marys	8	200	30	6.6 -2 hr	100	11,000

Total 1974 Pumpage 1.1 MGD

* estimated from specific capacity, well diameter, and time of pump test (Walton, 1970)

WELL CHARACTERISTICS IN THE PERDUE, INC. WELL FIELD. ACCOMAC

SWCB Number 100-	Owner's Number	Screen Depth	Geologic Formation	Diameter (in)	Test Yield (gpm)	Drawdown (ft)	Specific Capacity (gpm/ft)	Operational Yield (gpm)	Approximate* Transmissivity (gpd/ft)
30	#1	204-238 256-288 298-304	St. Marys Yorktown	10	280	144	2.3 -24 hr	270	5000
26	#2	204-240 256-292	St. Marys Yorktown	10	503	112	4.4 -24 hr	590	9000
29	#3	202-238 258-294	St. Marys Yorktown	10	501	116	5.6 -24 hr	590	12,000
195	#4	218-244 260-304	St. Marys Yorktown	10	-	-	2.8 -24 hr	340	7000
20	#4A	131-141 151-161 176-186 233-243 266-276	St. Marys Yorktown	10	99	39	2.5 -72 hr	100	7000

Total 1974 Pumpage 2.1 MGD

* estimated from specific capacity, well diameter, and time of pump test (Walton, 1970)

WELL CHARACTERTISTICS IN THE EXMORE FOODS WELL FIELD, EXMORE

SWCB Number 165-	Owner's Number	Screen Depth	Geologic Formation	Diameter (in)	Test Yield (gpm)	Drawdown (ft)	Specific Capacity (gpm/ft)	Operational Yield (gpm)	Approximate* Transmissivity (gpd/ft)
33	#1	230	Yorktown	6	-	-	-	50	-
-	#2, #3, #4 abandoned	-	-	-	-	-	-	-	-
35	#5	58	Pleistocene	8	-	-	-	-	-
38	#6	196	Yorktown	8	-	-	-	150	-
5	#7	142-157 188-218	Yorktown	8	-	-	4.3	350	8,000
29	#8	130-155 188-203 212-217	Yorktown	8	-	-	4.1 -12 hr	330	8,000
39	#9	132-137 144-159 188-218	Yorktown	10	-	-	10.0 -24 hr	300	21,000

Seasonal Pumpage - Total 1974 Pumpage .22 MGD

* estimated from specific capacity, well diameter, and time of pump test (Walton, 1970)

APPENDIX B

Well Data

The following table is a compilation of well data from wells in the Eastern Shore Peninsula. This table and Appendices C, D, and E can be used to obtain detailed ground-water information in areas of interest within the Peninsula. The information in Appendix B includes:

- State Water Control Board Well Number (SWCB No.)
- Name and Location of the well
- Virginia Plane Coordinate locations of the well. Virginia Plane Coordinate location grids appear on all U.S.G.S. topographic quadrangles. The north and east coordinates provide the exact location of the well
- Static water level below land surface (SWL LSD) in the well and date of measurement
- Total Depth (TD) of the well
- Elevation (ELEV) of the well
- Casing Diameter (CAS DIA)
- Pump Test Data, which include the specific capacity (SP CAP) in gallons per minute per foot of drawdown and the duration (HRS) of the pump test.
- Available well logs, which include Drillers Log (D), Electric Log (E) and Gamma-Ray Log (G)
- The depth of the screens in the well
- The number of the U.S.G.S. Topographic Quadrangle on which the well is located (TOPO #) (See Table 1-B)

The information in Appendix B can be used to determine the depth to aquifers, the water levels in the aquifers and the yield capabilities of the aquifers. In addition, chemical analyses for many of the wells listed are presented in Appendices B and C.

USGS TOPOGRAPHIC QUADRANGLE NAMES

BWCM MAP #	QUADRANGLE NAME
120-B	Accomac
142-D	Bloxom
163-D	Boxiron
94-D	Cape Charles
93-C	Cheriton
64-D	Chesapeake Channel
143-D	Chesconassex
141-B	Chincoteague East
141-B	Chincoteague West
93-D	Cobb Island
143-A	Crisfield
64-A	Elliotts Creek
144-A	Ewelll
121-D	Exmore
63-C	Fisherman's Island
93-B	Franktown
163-C	Girdletree
143-B	Great Fox Island
92-C	Great Machipongo Inlet
142-A	Hallwood
121-C	Jamesville
120-A	Metomkin Inlet
121-B	Nandua Creek

BWCM MAP #	QUADRANGLE NAME
93-A	Nassawadox
142-C	Parksley
164-D	Pocomoke City
121-A	Pungoteague
92-A	Quinby Inlet
142-B	Saxis
63-A	Ship Shoal
143-C	Tangier Island
63-B	Townsend
120-C	Wachapreague
141-C	Wallops Island
162-C	Whittington Point

SWCB NO.	NAME AND LOCATION	VA PLANE COORD Z	NORTH	EAST	DATE MO	YR	SWL LSD	TD (FT)	ELEV	CAS DIA		PUMP TEST YIELD	DRDN	LOG	* * ZONES OF DEVELOPMENT FROM	TO	FROM	TO	FROM	TO * *	TOPO #
100	ACCOMACK																				
1	TOWN OF PARKSLEY #1	2	540500	2823100	05	47	19	200	40	08	06	22	86	D	0129	0160					142-C
2	TOWN OF ONANCOCK #2	2	512900	2800000	05	66	12	282	25	18	08	203	91	DEG	0108	0123	0130	0145	0168	0188	120-B
3	GULF STREAM NURSEY#3	2	471000	2811000	12	68	5	304	10	08		192	163	D	0174	0194	0204	0224	0252	0267	120-C
4	TOWN OF ONACOCK #1	2	512800	2800000	01	53	9	165		10		147	125	D	0106	0110	0110	0119	0119	0156	120-B
5	JOHN H DULANY & SON				05	41	30	304		10	06	260	120	D	0209	0215	0277	0285			121-D
6	BYRD PACKING CO #1	2	532000	2818200	05	66	23	294	37	08		503	430	DE	0170	0215	0236	0266			142-C
7	USGS TEST HOLE				09	53		452		03				DE	0369	0374					142-A
8	USGS TEST HOLE				08	53		460						DE							120-B
9	HOLLY FARMS POULTRY-4	2	579000	2849500	12	67	23	330	35	08	06	195	19	DE	0132	0140	0156	0170	0196	0208	142-A
															0214	0222	0226	0234	0272	0287	
10	HOLLY FARMS POULTRY-3	2	579000	2849500	11	67	26	320	40	08	06	167	42	DE	0138	0146	0158	0172	0200	0212	142-A
															0216	0224	0234	0242	0273	0288	
11	HOLLY FARMS POULTRY-2	2	579000	2849500	11	67	25	295	40	08	06	250	89	DE	0138	0146	0157	0171	0200	0212	142-A
															0216	0224	0234	0242	0273	0288	
12	HOLLY FARMS POULTRY-1	2	579000	2849500	05	66	25	307	40	18	06	254	65	DE	0134	0149	0150	0173	0205	0215	142-A
															0219	0229	0240	0250	0274	0289	
13	TOWN OF PARKSLEY # 2	2	540500	2823100	06	46	13	74		08	06	165	47	D	0045	0064					142-C
14	TOWN OF PARKSLEY				04	50	5	90		14	06	100	48	D	0045	0057	0057	0068	0069	0078	142-C
15	NASA						9	150		02		35	24	DE	0045	0055					
16	NASA						9	156		02		38	25	DE	0045	0055					
17	NASA	2	563400	2871400	10	66		260						DE							141-C
18	NASA #2				01	61	6	153		08	06	26	115	D	0125	0140					141-C
19	MESSICK & WESSELLS	2	553400	2842500	04	69	30	252		08	04	50	180	D	0236	0246					142-D
20	PERDUE FOODS INC #4A	2	522200	2821000	03	70	30	350		18		99	39	D	0131	0141	0151	0161	0176	0186	120-B
															0233	0243	0266	0276			
21	PERDUE FOODS INC OBS	2	517720	2797600	12	69	7	190		02				D	0097	0107	0115	0125	0135	0145	
															0161	0181					
22	PERDUE FOODS INC OBS				12	69	7	190		02				D	0097	0107	0115	0125	0135	0145	
															0161	0181					
23	PERDUE FOODS OBS #3	2	252400	2823280	03	70	22	300				70	150	DE							120-B
24	PERDUE FOODS INC OBS				3	70	25	290		02		17		D							
25	PERDUE FOODS INC OBS				3	70	29	290		02		15		D							
26	PERDUE FOODS, INC #2	2	524070	2823200	04	70	23	325		10	08	503	112	D	0204	0240	0256	0292			120-B
27	PERDUE FOODS OBS #1	2	517740	2797560	12	69	6	350	22	08	06	162	51	DE	0097	0107	0116	0126	0135	0145	
															0162	0182					
28	TN OF CHINCOTEAGUE #4	2	520002	8223200	06	51	14	262		08		300	101	D	0217	0245					141-B
29	PERDUE FOODS INC #3	2	525000	2822320	07	70	26	325		10	08	503	90	D	0202	0238	0258	0294			120-B
30	PERDUE FOODS INC #1	2	255860	2824420	06	70	23	330		10	08	280	121	D	0204	0238	0256	0288	0298	0304	120-B
31	FIRST CHARTER LAND CO CAPTAINS COVE SUB				7	70	8	200		06		63	160	D	0168	0178					
32	TOWN CHINCOTEAGUE #5				01	72	16	256		16	08	118	74	D	0223	0256					141-B
33	VA DEPT OF HIGHWAYS	2	513950	2817500	1	61		285	40	03		30	60								120-B
34	MARY SMITH HIGH SCH	2	525000	2823000	08	70	22	295		06		35	6								120-B
35	ACCOMACK COUNTY	2	517020	2818300	3	68	30	295	44	04		50	118		0275	0295					120-B

NOTE--AN ASTERISK (*) IN "Z" UNDER "VA PLANE COORD" INDICATES A LATITUDE-LONGITUDE LOCATION--ALL OTHERS ARE VPC

SWCB NO	NAME AND LOCATION	Z	VA PLANE COORD NORTH	EAST	DATE MO	YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	DRDN	LOG	ZONES OF DEVELOPMENT FROM	TO	FROM	TO	FROM	TO	TOPO #
100	ACCOMACK																			
36	TOWN OF ONANCOCK	2	512580	2797650																121-A
37	TOWN OF ONANCOCK	2	514110	2795300																121-A
38	TOWN OF ONANCOCK	2	514120	2795360	06	71			183											
39	FIRST CHARTER LAND CO CAPTAINS COVE				6	71	22	410		06	93	252	D	0255	0270					
40	WALKER SCHOOL	2	515480	2816220	10	69	6	45		02	30	14								120-B
41	ACCOMAC NURSING HOME	2	531750	2831600	5	69	19	142		06	40	21	D							142-D
42	ACME SUPERMARKET	2	508800	2804380	07	69	21	190		06	40		D	0170	0180					
43	MARVIN KILLMAN	2	510360	2793150	2	69	5	176	15	02	40	10	D							
44	ANNIE MASON	2	493500	2771900	3	69		163	7	02	50	15	D							
45	MARY BARNES	2	524150	2814100	3	69	33	295	42	02	18	22	D							
46	JOHN A DAVIS	2	493560	2816950	5	69		210	7	02	33	21	D							
47	CLARENCE COURTNEY				5	69	1	92		02	35	37	D							
48	ONLEY SWIMMING POOL	2	503700	2805440	5	69	19	187	42	04 02	20	19	D							120-B
49	PRETTYMAN & PRINCE				6	69	10	127		02	20	18	D							
50	JACK MASON	2	516050	2817820	6	69	21	142	42	02	33	29	D							
51	DAVID NORTHAM	2	505600	2804250	6	69	27	195	46	02	20	33	D							
52	IRA DAVIS	2	529850	2804680	6	69	4	118	12	02	40	16	D							
53	WILLIAM TURNER	2	515950	2810650	6	69	22	161	45	02	15	38	D							
54	BYRD PACKING CO	2	531210	2818100																
55	FLOYD HOGLE	2	509550	2824800	6	69	9	147	16	02	23	19	D							
56	CHANDLER				7	69	34	292		02	18	26	D							
57	WARNER KILLMAN				7	69	18	200		02	28	12	D							
58	CLIFTON GREENE				7	69	30	296		02	18	25	D							
59	R YOUNG	2	506130	2804350	8	69	23	180	43	02	33	32	D							
60	PAUL KENNEDY	2	517950	2817800	8	69	33	300	45	02	17	21	D							
61	PETE PEW	2	506050	2804400	8	69	23	180	43	02	37	32	D							
62	VALENTINE	2	519400	2832000	8	69	3	190	10	02	20	15	D							
63	JACK MALES	2	516700	2819120	8	69	27	295	35	02	18	28	D							
64	LEWIS BROTHERS	2	516300	2824400	9	69	22	295	23	02	20	33	D							
65	BENJAMIN F GUNTER	2	532630	2807630	10	69	5	135	11	02	25	15	D							
66	D TURNERS TRAILER CT	2	495250	2812650	10	69	8	150	25	02	20	22	D							120-B
67	G Y CAMPBELL	2	528300	2803730	10	69	6	170	12	02	30	14	D							
68	CHARLES ANGLE	2	494700	2772550	11	69	1	165	7	02	47	9	D							
69	P VON DESSEL				11	69	12	90		02	25	8	D							
70	ROBERT WHITE	2	501550	2793350	12	69	11	124	30	02	50	12	D							
71	CHARLES CHANDLER	2	504150	2806150	1	70	20	180	44	02	40	15	D							
72	FRANKLIN L DAVIS	2	512300	2783330	1	70	3	90	7	02	33	12	D							
73	WILLIAM JUSTICE				3	70	18	102		02	20	12	D							
74	JOE KELLAM	2	508550	2813050	4	70	21	190	45	02	17	19	D							
75	DONALD MEARS				4	70	19	180		02	28	11	D							
76	EDWARD WATKINSON				04	70	2	214		02	22	18	D							
77	JAMES MARTIN				4	70	28	297		02	18	30	D							
78	JOHN A JOHNSON SR	2	525350	2829400	5	70	19	145	30	02	30	10	D							

NOTE--AN ASTERISK (*) IN "Z" UNDER "VA PLANE COORD" INDICATES A LATITUDE-LONGITUDE LOCATION--ALL OTHERS ARE VPC

SWCB NO	NAME AND LOCATION	VA PLANE COORD 7	NORTH	EAST	DATE MO	YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	DRDN	LOG	ZONES OF DEVELOPMENT FROM	TO	FROM	TO	FROM	TO	TOPO #
100	ACCOMACK																			
79	ROBERT F CARR				5	70	4	140		02	18	15	D							
80	HELEN ROACH	2	494540	2772430	6	70		165	7	02	50	10	D							
81	RALPH JENKINS				7	70		165		02	50	12	D							
82	JOHN KAUFFMAN				5	70	16	205		02	22	9	D							
83	MARY SELBY	2	492350	2816210	5	70	25	217	6	02	15	25	D							
84	SHORE HOMES INC				6	71		172		02	50	15	D							
85	JOE KNIGHT	2	492000	2817430	6	70	3	218	9	02	17	19	D							
86	BILL WATSON	2	505900	2804020	6	70	23	193	44	02	17	20	D							
87	DAVE WESSELS	2	522760	2816420	6	70	19	172	45	02	20	26	D							
88	ACCOMACK CO BUS SHOP	2	532050	2831100	6	70	23	144	36	02	35	30	D							
89	MAJOR POULSON JR	2	532500	2807730	7	70	4	128	11	02	27	16	D							
90	DAEFI				7	70	22	182		02	30	8	D							
91	GEORGE HUDSON	2	530600	2805440	7	70	4	138	12	02	33	8	D							
92	ABC STORE				7	70	21	177		02	40	25	D							
93	C F EWELL				7	70	30	162		02	17	31	D							
94	EASTERN SHORE SEAFOOD	2	527450	2804400	8	70	4	182	15	02	23	16	D							142-C
95	NATHANIEL WILLIAMS				8	70	19	230		02	30	21	D							
96	L FLOYD NOCK				8	70	6	142		02	20	22	D							
97	LELAND HELMSTETTER	2	529000	2791200	08	70	3	102		02	27	12	D							143-D
98	DOROTHY FINNEY				8	70	14	178		02	17	14	D							
99	DWIGHT PHILLIPS				8	70	19	160		02	15	16	D							
100	NORMAN TAYLOR	2	538000	2814000	09	70	9	235	18	02	22	13	D	0225	0235					142-C
101	ROBERT BONNIWELL				9	70	27	295		02	15	30	D							
102	OLDHAM POWELL	2	513800	2809150	9	70	20	165	38	02	30	12	D							
103	GERALD FRANCIS				9	70	15	140		02	25	10	D							
104	LINDSEY FORBES	2	510950	2789800	9	70	8	110	10	02	33	12	D							
105	SHELDON RAPPAPORT				9	70	5	80		02	35	16	D							
106	MELVIN LEWIS				9	70	28	297		04 02	17	57	D							
107	JAMES A STRAND				9	70	19	180		02	21	19	D							
108	RICHARD YOUNG				10	70	23	150		02	15	37	D							
109	DR. ISAAC WHITE	2	251620	2788100	10	70	5	110	7	02	25	15	D							121-A
110	ROBERT EDWARDS	2	505150	2795150	10	70		105	17	02	23	15	D							
111	M O EVANS				10	70	16	130		02	40	12	D							
112	H P DOBSON	2	519720	2784820	10	70	3	120	6	02	22	15	D							
113	CARLISLE V DIZE	2	494550	2772600	10	70	2	160	7	02	55	10	D							
114	JACK MASON				10	70	3	162		02	40	20	D							
115	MINNIE DIZE				10	70	4	101		02	30	16	D							
116	BAPTIST PARSONAGE				10	70	28	296		02	17	30	D							
117	EDWARD HAYFIELD	2	529900	2804160	11	70	4	120	10	02	18	16	D							
118	O MEARS				11	70	2	120		02	23	16	D							
119	BAPTIST CHURCH				11	70	28	298		02	19	27	D							
120	FAIRHURST	2	527270	2789050	11	70	5	115	6	02	18	17	D							
121	GEORGE JUSTICE	2	523350	2785900	11	70	28	180	6	02	22	14	D							
122	CARRIE BARNES	2	523350	2785900	12	70	4	120	6	02	22	16	D							

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SWCB NO	NAME AND LOCATION	Z	VA PLANE COORD NORTH	EAST	DATE MO	YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	DRDN	LOG	ZONES OF DEVELOPMENT FROM	TO	FROM	TO	FROM	TO	TOPO #
100	ACCOMACK																			
123	JOHN S WISE	2	524800	2790210	12	70	3	112	6	02	22	17	D							
124	CLIFF TIDINGS	2	511550	2793700	1	71	4	92	15	02	22	18	D							
125	MRS RICHARD HOLLERITH	2	515850	2818250	1	71	21	285	42	02	17	25	D							
126	ACCOMAC DRUG STORE	2	516000	2817830	1	71	22	152	44	02	35	23	D							
127	CHARLES O GRINSTEAD	2	508700	2827500	2	71	20	155	8	02	25	8	D							
128	HENRY J CALVER	2	528900	2803950	2	71	7	160	12	02	23	20	D							
129	FLETCHER EWELL	2	524450	2814530	2	71	20	178	43	02	15	15	D							
130	ABEL ASHBY	2	516600	2818400	2	71	9	155	42	02	25	11	D							
131	VIRGINIA SMULLEN	2	536220	2814100	3	71	22	182	24	02	25	16	D							
132	RAW.WATSON.EVANS.YOUN				4	71	22	170		02	22	30	D							
133	VIRGINIA WHEATON	2	525500	2815000	4	71	37	298	42	02	15	33	D							
134	ANNIE WEST	2	520600	2794900	4	71		170	12	02	20	12	D							
135	JOSEPH KICEK	2	508400	2793280	4	71	7	170	15	02	23	13	D							
136	BARRY MEARS	2	525620	2814750	4	71	21	180	40	02	15	17	D							
137	EDWARD WATKINSON	2	524000	2830450	05	71	6	212	26	02	22	16	D							120-B
138	BENNIE WILSON	2	517020	2811600	5	71	18	168	40	02	28	25	D							
139	MILDRED WATKINSON	2	507950	2805300	5	71	22	180	44	02	16	13	D							
140	IDA WILLIAMS				5	71	23	170		02	33	30	D							
141	RUSSEL PARKS				5	71	17	142		02	23	11	D							
142	F L GOLWIN	2	491980	2816780	5	71	26	130	10	02	25	15	D							
143	FRED W CONQUEST	2	525250	2814630	5	71	6	128	41	02	23	12	D							
144	MARION KILLMAN				6	71	7	175		02	33	11	D							
								177	45	02	25	12		0167	0177					
								177	45	02	25	12								
146	ALBERT C JOHNSON JR				7	71	25	170		02	15	35	D							
147	R WORTH	2	519650	2799000	7	71	35	298	17	02	17	50	D							
148	ESTELLA KELLAM	2	545310	2818480	8	71	5	165	10	02	18	15	D							
149	ERNEST HART	2	504300	2820150	8	71	14	116	21	02	18	12	D							
150	RALPH EDWARDS				8	71	34	176		02	18	16	D							
151	HENRIETTA TAYLOR	2	532950	2811250	9	71	1	168	17	02	40	9	D							
152	RONNIE TAYLOR				9	71	4	220		02	20	12	D							
153	PITTARD	2	506620	2805730	9	71	12	144	45	02	15	15	D							
154	E MEARS	2	525600	2827880	9	71		170	33	02	40	10	D							
155	JOHN PEPPLER	2	506150	2803450	9	71		172	45	02	42	8	D							
156	EMMET MICHAELS	2	501350	2793200	9	71	42	298	30	04 02	15	28	D							
157	JACK JOHNSON				9	71	17	110		02	23	10	D							
158	SHORE HOMES INC				1	69	11	138		02	19	30	D							
159	JOHN E WHITE				1	69	25	165		02	17	25	D							
160	NORMAN JUSTICE				1	69	1	90		02	20	19	D							
161	WILLIAM L CROKETT TANGIER CRAB CO	2	553100	2724500	8	71	7	991		04 02	40		E	0971	0986					143-C
162	TOWN OF ONLEY				10	71	23	190		06	275	52	D	0170	0190					120-C
163	VA DEPT OF HIGHWAYS				04	72	27	137		06	66	68	D	0126	0136					142-D
164	CHINCOTEAGUE AIR STA				3	47	19	59		08	85	17	D							

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SWCB NO	NAME AND LOCATION	VA PLANE COORD Z NORTH EAST	DATE MO YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	PUMP TEST DRDN	LOG	* * ZONES OF DEVELOPMENT * * FROM TO FROM TO FROM TO	TOPO #
100	ACCOMACK											
165	FIRST CHARTER LAND CO CAPTAINS COVE SUB	.	04 72	11	355		06	180	150	D	0257 0272	141-A
166	CHESTER PETITT JR		68	24	172					D		
167	BROOKS SMITH		68	27	280					D		
168	WATKINSON		68	29	298					D		
169	EVELYN WHITE		68	20	150					D		
170	EDGAR THOMAS		68	25	190					D		
171	ERNEST JOHNSON		68		120					D		
172	FITCHETT		68	7	212					D		
173	WALTER DIX		68	26	160					D		
174	ALFRED AYRES		68	21	178					D		
175	SATCHELL		68	35	292					D		
176	SHORE HOMES INC		68	12	182					D		
177	BROOKS JOHNSON FISHERS CORNER		68	18	173					D		
178	HORNE & STAUFFER		68	24	186					D		
179	LOUISE DUNTON		68	9	140					D		
180	W W LORD		68	9	165					D		
181	JACK GORDY		68	28	285					D		
182	BURCKHARDT		68		216					D		
183	NATE WILLETT	2 548500 2825100 00	68	4	238					D		142-C
184	ANNA MCSPEAD		68	10	128					D		
185	HERBERT BARNES		68	29	306					D		
186	FLOYD NOBLE III		68	21	143					D		
187	NEW GANLE		68	21	163					D		
188	GEORGE R PARKS		68	120	160					D		
189	CHARLES W PARKS		68	2	170					D		
190	LEVIN LEWIS		68	2	160					D		
191	W MARTIN		68		165					D		
192	NORMAN REED		68	1	160					D		
193	L R JUSTIN JR		68	12	76					D		
194	ALBERT C JOHNSON			23	117	41	02					120-B
195	PERDUE FOODS INC #4		07 72	70	331		10 08	302	109	D	0218 0244 0260 0304	
196	HOLLY FARMS POULTRY#5		04 68	60	365	35	18 08	200	30		0130 0138 0152 0166 0214 0222 0226 0234 0270 0285	142-A
197	NASA WALLOPS ISLAND		07 63	14	64		18 06	50			0045 0055	
198	NASA WALLOPS ISLAND		05 53	15	228		08	137			0140 0145 0205 0225	
199	NASA WALLOPS ISLAND		07 63	14	55		06	50	14		0040 0050	
200	NASA WALLOPS ISLAND		08 45	28	54	33	08		16		0044 0054	
201	NASA WALLOPS ISLAND		10 47	24	60	23	08	60	34		0030 0035 0050 0055	
202	NASA WALLOPS ISLAND		07 53	8	183	6	06	18			0167 0177	
203	NASA WALLOPS ISLAND		02 53	26	62		08	60			0047 0062	
204	NASA WALLOPS ISLAND		04 47	14	45		08	100	30		0028 0033 0035 0040	
205	NASA WALLOPS ISLAND		08 48	46	120	33	08				0110 0120	

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SWCR NO	NAME AND LOCATION	VA PLANE COORD Z	7 NORTH	EAST	DATE MO	YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	DRDN	LOG	* * ZONES OF DEVELOPMENT FROM	TO	FROM	TO	FROM	TO * *	TOPO #
100	ACCOMACK																			
206	NASA WALLOPS ISLAND				08	48		59		08	80			0049	0059					
207	NASA WALLOPS ISLAND				11	47	24	65	33	08	60	35		0050	0060					
208	NASA WALLOPS ISLAND				01	53		91		08				0043	0048	0079	0089			
209	NASA WALLOPS ISLAND				07	48	20	53		08	96	36		0040	0045	0048	0053			
210	NASA WALLOPS ISLAND				02	53		80		08	65			0064	0079					
211	TOWN OF ONANCOCK				3	27	12	210		04	115									
212	CHINCOTEAGUE DEV CORP							40		02	30									
213	TOWN OF TANGIER #1							915						0900	0915					
214	TOWN OF TANGIER							1033	2	04 02			E	1012	1027					143-C
215	TOWN OF WACHAPREAGUE	2	475000	2815000			1	385			6									120-C
216	VA DEPT OF HIGHWAYS	2	616200	2854000	03	67	12	132		06	130	29		0120	0130					142-A
217	U S COAST GUARD							320												
218	GREENBRIAR DEVELOP CO				07	73	15	310		06	30	134	D E	150	170					
219	WALLOPS STATION-NAVY (USGS OBS. WELL)							60		08										141-B
220	GREENBRIAR DEVEL. CO.				07	74	25	73		08	120	50	D	0055	0070					141-A
221	LANCE FISHER OYSTER				04	74	3	135			50	42		0100	0140					142-D
222	C C HUMBLES FUNERAL HOME							50												
223	C C HUMBLES FUNERAL HOME						100	170												
224	WADE MOORE				00	48	13	194	25		15			0155	0165	0184	0194			120-B
225	W AYRES COARD	2	518000	2821000	07	73	15	155				25		0145	0155					120-B
226	W AYRES COARD				06	74	15	140				25								120-B
227	ARCHIE CROPPER	2	517500	2821500	08	74	24	160												120-B
228	WALTER MARKS	2	517800	2822000	09	74	58	298						0226	0240					120-B
229	J W TAYLOR PACKING CO				00	54		246	25		194			0226	0246					142-A
230	CHARLES MARTZ				07	74	32	164			25	15								142-C
231	GEORGE BALDWIN				06	70	7	140		02	17	13		0135	0140					142-A
232	BOBBY J FLOWERS				09	71	24	110		02	27	24		0100	0110					
233	VERNON JUSTICE	2	608100	2880600	03	70	28	165			18	28		0150	0160					141-B
234	RICHARD THORNTON JR	2	585000	2864000	04	74	28	300	35			38		0285	0300					142-A
235	BONNIE BISHOP	2	558000	2852000	03	73	8	157			33	13		0147	0157					142-D
236	THOMAS J PICKINE	2	350000	2848000	12	73	20	220			18	30		0200	0220					142-D
237	H V DREWER & SON #1				02	70	8	195		04	32	59		0185	0195					142-B
238	H V DREWER & SON #2				05	73	3	115		04	50	52		0085	0115					142-B
239	KEITH MILES				00	55		100						0090	0100					121-A
240	JOHN W CAMPBELL MERCURY DEALERSHIP	2	478000	2793000	00	48	28	265	42	02	15									121-D
241	KENNETH MILES	2	510000	2788000	12	74	5	105	7		25	9		0095	0105					121-A
242	JAMES & ESTHER TIEMAN	2	482000	2779000	01	71	23	165			30	17		0150	0160					121-A
243	JOE EASTON	2	466500	2787000	06	74	12	90	40		19	12		0080	0090					121-D
244	JOHN HOLDEN							220						0212	0220					142-B

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100	ACCOMACK																		
245	COMMONWEALTH OF VA EAST SHORE COMM COL						290												120-B
246	JACK AUGUST PACKING	2	475000	2815000	11 70	1	305	10	06	130	90								120-C
247	T & W SEAFOOD								06										
248	FISHER BROS SEAFOOD						140						0100	0140					
249	VA TRUCK EXPER STATN	2	465000	2775000	12 63		167		04				0147	0167					121-D
250	L. W. GROTON	2	455000	2762000	08 70	235	175			1400			0240	0165	0175				121-D
251	D ATKINSON-L STAUFFER	2	455000	2777000	07 71	32	208			22	13		0198	0208					121-D
252	W MAPP	2	455100	2799000	00 52		210	5	02										120-C
253	BOB LYDA	2	506000	2806000		22	180				13		0170	0180					120-B
254	NORMAN WAYNE TAYLOR	2	474700	2813000	08 74	7	130			22	11								120-C
255	PRESTON LANKFORD	2	558000	2853000	00 51		265	25	02										142-D
256	BILL STERLING				10 73	25	163		02	40	36		0153	0163					
257	F T HUBER	2	445000	2772000		5	165		02		12		0155	0165					121-A
258	H E KELLEY CO	2	612500	2853000			259	25	10 08	254									142-A
259	JOSEPHINE METCALF BLUE BONNET BEAUTY	2	563500	2847000			255		02										142-D
260	FRED HALL	2	575000	2845100	00 49		265	30	02										142-D
261	ACCOMAC HOTEL																		
262	ACCOMAC COURT HOUSE																		
263	TOWN OF ACCOMAC																		
264	PAGE FISHER				00 49		250	30		15									142-A
265	TOWN OF CHINCOTEAGUE				00 29		40			90									
266	GARDISE DEVELOPMENT						300						0280	0300					
267	ERNEST MELCHIONE	2	517500	2820000		12	45	42	02	20	16		040	45					120-B
268	DR WILLIAM TURNER	2	216500	2817000		25	155	42	02	16	20		0147	0155					120-B
269	LESLIE TRENT	2	525500	2821500		35	50	43	02	23	3		045	55					120-B
270	WILLIAM BELOTE	2	512500	2821500		15	160	24	02	23	20		0150	0160					120-B
271	COL VILLAGE MOBILE PK	2	520000	2822000		25	165	43	02	23	45		0145	0165					120-B
272	LEWIS BROS LUMBER CO	2	513600	2826000		9	29	25	02	10			0285	0295					120-B
273	L L LEWIS	2	514000	2826000		3	295	25	02	20	33		0285	0295					120-B
274	PERDUE FOODS	2	523000	2813000		25	42	35	02		12		037	42					120-B
275	LEWIS BROS RACE TRACK	2	514000	2826000		20	290	25	02	15	35		0280	0290					120-B
276	JACK GUNDY #1	2	516500	2818500		16	285	44	02	10	27		0275	0285					120-B
277	W AYRES COARD	2	520000	2822500		3	298	37	02	11	30		0288	0298					120-B
278	W AYRES COARD	2	520000	2822000		23	140	38	02	10	30		0125	0140					120-B
279	W AYRES COARD	2	517000	2818500		15	300	37	02	20	23		0280	0300					120-B
280	W AYRES COARD	2	520500	2823000		27	155	42	02	10	25		0145	0155					120-B
281	BRADLEY SIMPSON	2	520500	2812000		18	160	42	02	10	16		0150	0160					120-B
282	ELKS CLUBB.....	2	525700	2814500		24	178	47	02	25			0168	0178					120-B
283	BRIGHTSON MOTOR CO	2	517000	2823000		30	52	41	02	21	12		042	52					120-B
284	CLARENCE W LEWIS	2	514000	2818000		19	180	43	02	21	14		0165	0180					120-B
285	IRVING AMADO	2	510000	2806000		17	180	41	02	40	25		0170	0180					120-B
286	SHORE DISTRIBUTING	2	507000	2807500		18	180	41	02	36	7		0170	0180					120-B

NOTE--AN ASTERISK (*) IN "7" UNDER "VA PLANE COORD" INDICATES A LATITUDE-LONGITUDE LOCATION--ALL OTHERS ARE VPC

SWCB NO	NAME AND LOCATION	VA PLANE COORD 7 NORTH	EAST	DATE MO YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	DRDN	LOG	* * ZONES OF DEVELOPMENT * * FROM	TO	FROM	TO	FROM	TO	TOPO #
100	ACCOMACK																	
287	NED MCGRATH	2 504500	2808200		22	180	45	02	36	7		0170	0180					120-B
288	STANLEY LEWIS	2 204500	2808000		20	195	45	02	20	25								120-B
289	DAVE WESSELS	2 525000	2817000		16	174	42	02	20	16		0164	0174					120-B
290	JOE BERNARD	2 524400	2816500		17	168	43	02	10	24		0158	0168					120-B
291	JOHN WILLIAM CONQUEST	2 567200	2843000		34	245	46	04	50	36		0225	0245					142-D
292	BILL THORION	2 571500	2849500		11	220	47	02	20			0210	0220					142-D
293	ANDREW HALL	2 584600	2941700		10	190	23	02	16	42		0170	0190					142-A
294	EASTERN SHORE ACADEMY	2 574500	2841000			277	23	02	25	30		0257	0277					142-A
295	EDDIE PLANTER	2 592300	2854200		17	215	42	02	20	30		0210	0215					142-A
296	RHODES BROTHERS	2 573300	2849500		40	67	47	04	60	18		052	67					142-D
297	ELEANOR TAYBRON	2 581000	2851000		38	140	42	02	20	24								142-A
298	JACK CUTLER	2 580000	5810000		3	238	42	02	16	18		0228	0238					142-A
299	CLARENCE WRIGHT	2 582300	2852000		9	240	34	02	20	17		0235	0240					142-A
300	A J GRAY & SON	2 582500	2849000		11	60	40	02	25	15		050.	60					142-A
301	A J GRAY JR HOG FARM	2 582500	2849000			280	40	02	50	50		0200	0230	0270	0280			142-A
302	ELSIE MEARS	2 579400	2851300	12 54		235	92	02		22		0222	0235					142-A
303	BARTON CROPPER	2 582100	2850500		2	235	38	02	10	22		0225	0235					142-A
304	MRS JOHN LEWIS	2 551000	2851000			240	42	02	20	27		0230	0240					142-A
305	S H HACKLE JR	2 504000	2742000			178	13	02	23	7		0168	0178					121-A
306	FRED WISE	2 526000	2805000			133	12	02	50	23								120-B
307	GREGGORY ELLIS	2 575000	2560500		21	212	8	02		11		0202	0212					142-D
308	HASTINGS TRUCKING CO	2 589200	2857000			180		02	19	49		0170	0180					142-A
309	MILTON POULSON	2 575000	2840000			220	18	02	18	23		0210	0220					142-A
310	GENE TRENT	2 540000	2820000		17	155	32	02	21	9		0145	0153					142-C
311	JULIA WHITE	2 540000	2820000		12	150	32		25	40		0140	0150					142-C
312	JOE REW	2 539000	2819500		26	45	33		23	10		040.	45					142-C
313	MERCER WALTON	2 549000	2816000		2	240	7	02	21	23								142-C
314	ROGER RAWSON	2 501000	2745000		6	120	10		21	14		0110	0120					121-A
315	WILBERT MEEDAR	2 505700	0819200		13	113	26	02	21	13		0103	0113					120-B
316	GARRISH BUILDERS #4	2 507000	2815000		32	40	41	02	20	8		035	40					120-B
317	T & W SEAFOOD							06										

SWCR NO	NAME AND LOCATION	VA PLANE COORD 7 NORTH	EAST	DATE MO YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	DRDN	LOG	* * ZONES OF DEVELOPMENT * * FROM TO FROM TO FROM TO	TOPO *
165	NORTHAMPTON												
1	NORTHAM-ACCOMAC HOSPI			2 69	21	375		08 06	175	118	D	0160 0170 0218 0238 0271 0286	93-A
												0296 0301	
2	MACHIPONGO HIGH SCH			9 53	25	365		06	60	170	D	0211 0221 0248 0259 0291 0302	93-B
3	MACHIPONGO HIGH SCH			7 53		104					E		93-B
4	CAPEVILLE ELEM SCHOOL			7 53		461		03			E		63-B
5	EXMORE FOODS #7			02 67	26	240		08 06	300	70	D	0142 0157 0188 0218	121-D
6	UNITED FOODS. DULANY			41	30	304		08 06	260	120	D	0209 0215 0277 0285	121-D
7	CAPE CHARLES A F STA			8 60	3	93		06	11	33	D	0036 0046	
8	CAPE CHARLES A F STAT			08 60	4	152		06	14		D	0119 0129	63-B
9	TOWN OF EXMORE												
10	CAPE CHARLES A F STAT			11 54		85					D		
11	CAPE CHARLES A F STA			11 54		65					D		
12	CAPE CHARLES A F STA			11 54		58					D		
13	CAPE CHARLES A F STA			10 58	10	65		06	35	15	D	0051 0061	63-B
14	TOWN OF EXMORE #2			04 65	28	228		20 08	285	72	D	0150 0212	121-D
15	TOWN OF EXMORE #1	I 452200	2776500	06 50	34	200	30	08	746	38	D	0160 0190	121-D
16	NOBLE HETTIE			10 28		150							
17	LONG H GOEFINGON			2 53	15	140		03 02	25		D	0130 0140	63-B
18	PHILLIP CURTIS			06 66		300					D	0093 0098 0152 0157 0265 0270	
19	VA AGRICULTURAL PROD			9 66		308					DE	0097 0102 0175 0195 0246 0251	
												0295 0300	
20	TOWN OF CAPE CHARLES			5 38		210					D		
21	WEBSTER CANNING CO					265					D		93-C
22	WEBSTER CANNING CO			4 37		280					D		93-C
23	WEBSTER CANNING CO			03 47		295					D		93-C
24	WEBSTER CANNING CO			5 56		370					D		93-C
25	NORTHAM-ACCOMAC HOSPI			10 52	21	321		18 06	121		D		93-A
26	TOWN OF EASTVILLE			2 70	27	320	28	06	100	15	D		93-C
27	CHERRYSTONE CPGROUND					310		08				0200 0205 0240 0255	
28	TOWN OF CAPE CHARLES	2 349950	2726000			80	10						94-D
29	EXMORE FOODS #8			03 71	32	280		18 06	307	75	D	0130 0155 0188 0203 0212 0217	121-D
30	TOWN OF EASTVILLE			52	21	138	30	04			D		93-C
31	TOWN OF EASTVILLE				19	111	30	06			D		93-C
32	J C WALKER BROTHERS			30		95							121-D
33	EXMORE FOODS #1					29							

SWCB NO	NAME AND LOCATION	VA PLANE COORD 7	NORTH	EAST	DATE MO YR	SWL LSD	TD (FT)	ELEV	CAS DIA	PUMP TEST YIELD	PUMP TEST DRDN	LOG	ZONES OF DEVELOPMENT FROM TO	FROM TO	FROM TO	TOPO #
165	NORTHAMPTON															
34	EXMORE FOODS #4															
35	EXMORE FOODS #5															
36	TOWN OF EASTVILLE				10 40	46	146		12	75						93-C
37	TOWN OF EASTVILLE															
38	TOWN OF EASTVILLE				9 72	18	165		06	110	75	D	0145 0165			93-C
39	EXMORE FOODS #9				04 74	39	280		10 08	290	29	D	0132 0137	0144 0159	0188 0218	121-D
41	BALLARD BROS FISH CO CHERRYSTONE CAMPGND	2	358100	2723700	02 70	1	268	3	04							94-D
42	AMERICAN HOUSE MOTEL	2	302750	2737750		19	70	5	04		7					63-B
43	HOLIDAY INN	2	319000	2749700	08 68	17	220	8	04				0200 0220			63-B
44	(LOW-COST HOUSING)	2	367500	2738100		27	310	15	04				0290 0310			93-C
45	C & D SEAFOOD	2	357300	2749650	12 74	35	185	1	06	95			0165 0185			93-C
46	WEBSTER CANNING-FARM	2	364300	2736300			312	18	06				0290 0310			93-C
47	WEBSTER CANNING-PLANT	2	358500	2738000	07 73	28	330		06	250			0100 0110 0300 0330	0200 0220	0260 0280	93-C
48	TOWN OF CAPE CHARLES	2	350200	2727000	03 73	15	210	10	06				080 100	190 210		94-D
49	NELSON DOUGHTY	2	442000	2781000		8	132			15	37					121-D
50	MRS. JOSEPH MEARS	2	452000	2751000	11 73	8	110			15	35					121-C
51	PST OFFICE-NASSAWADOX	2	425100	2767000	11 65	11	85			15	10					93-A
52	JERRY NOTTINGHAM				01 74	28	230									193-A
53	JOHN R TANKARD				05 72	15	220			30	25					93-B
54	UNKNOWN					22	195									93-B
56	CHANDLER KELLAM	2	350500	2745000												93-C
57	CANDLELIGHT LODGE	2	413000	2760000	08 65		295		03		36					93-A
58	PHIL COLSON				12 74	27	300			20	38					93-C
59	LUCY DIXON	2	305000	2738000	00 49		227	20	02							63-B
60	HARVEY BELOTE				00 67											63-B
61	HARVEY BELOTE & SONS				00 49		115	20	02							63-B
62	L D BULL				00 48	5	91	6	02	12						63-B
63	CHANDLER KELLAM	2	350500	2745000	04 66	5	115			45	16					93-C
64	C & D SEAFOOD						185						0165 0185			93-C
66	P C KELLAM	2	428000	2739100		17	77			16	35					93-B
67	W L CHANDLER	2	441000	2746000	00 53		82	20	02							121-C
68	RANLEY TANKARD	2	428000	2753000												43-B
69	JAMES BRADSHAW	2	384000	2728000	04 72	11	174						0164 0174			93-C
71	HARRY TAYLOR	2	402000	2761000	10 74	20	160			3	28					93-B
72	CARLTON RIGGIN	2	419000	2768000	04 69	26	320			21	55					93-A
73	MRS ANN GROSSINO															
74	GARDISE MEADOWS						310									
75	H ALLEN SMITH SEAFOOD						190						0158 0180			
76	MRS ANN GROSSINO															

NOTE--AN ASTERISK (*) IN "7" UNDER "VA PLANE COORD" INDICATES A LATITUDE-LONGITUDE LOCATION--ALL OTHERS ARE VPC

APPENDIX C

Groundwater Chemical Quality Data

The following table contains chemical quality data on groundwater in the Eastern Shore Peninsula. Well numbers on this table can be cross-referenced to Appendix B to determine the location and construction of the wells from which quality samples were taken. The data listed in Appendix C include:

State Water Control Board No.
Owner and or Location of the Well
Date Sampled
Depth of well
Screen Depths in well
Number (DWR No.)
The date the water sample was taken
The following chemical constituents in milligrams per liter (mg/l):

- Iron (Fe)
- Calcium (Ca)
- Magnesium (Mg)
- Copper (Cu)
- Lead (Pb)
- Manganese (Mn)
- Sodium (Na)
- Potasium (K)
- Bicarbonate (HCO_3)
- Alkalinity
- Sulfate (SO_4)
- Fluoride (F)
- Chloride (Cl)
- Nitrate (NO_3)
- Total Hardness
- Ca, Mg Hardness
- Total Solids
- Volatile/Fixed Solids
- Dissolved Solids
- Specific Conductivity
- pH
- TOC

The data in Appendix C is a composite listing of water samples taken by the State Water Control Board and by other governmental agencies. Additional hardness, chloride, total solids, and specific conductivity data can be found in Appendix D.

SWCB NO.	OWNER AND/OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKALINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/FIXED	DISSOLVED SOLIDS	SPEC COND.	PH	TOC
ACCOMACK COUNTY																										
100																										
1	Town of Parksley	4/22/60	200	129-160	.10	27.9	4.5	-	-	-	6.7	-	110	-	2.5	.2	7.3	0.0	88	88	123	-	-	-	7.6	-
1		1/5/72			0.0	9.8	7.7	-	-	-	16	3.7	11	-	33	.1	24	26	103	56	139	-	-	230	5.6	-
1		3/7/72			0.0	10	7.6	-	-	-	17	3.7	10	-	37	.1	24	28	56	56	147	-	-	235	5.5	-
1		6/1/72			.01	9.4	7.2	-	-	-	16	3.7	12	-	35	.1	20	26	96	53	139	-	-	240	5.7	-
1		12/9/74			0.1	30	5.2	-	-	.01	7.4	2.6	-	83	5.6	.11	-	.03	82	-	151	13/138	151	-	8.5	-
2	Town of Onancock	6/10/68	282	108-123 130-145 160-188	.07	27	8.8	-	-	-	33.8	-	190	-	1.2	.1	14.0	.5	104	104	204	-	-	-	7.7	-
2		5/69			-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	295	-	-
2		7/69			-	27	7.8	-	-	-	22	6.8	166	-	1.4	.2	10	.6	100	100	190	-	-	288	7.6	-
2		9/69			-	25	7.7	-	-	-	23	6.8	165	-	3.4	.3	8	.7	94	94	184	-	-	285	7.7	-
2		10/69			-	24	8.0	-	-	-	22	5.8	156	-	3.0	.2	8.2	2.6	93	93	173	-	-	277	7.6	-
2		11/69			.00	27	7.4	-	-	-	23	8.7	162	-	4.8	.3	9.9	.4	98	98	170	-	-	288	7.6	-
2		12/69			.00	30	5.2	-	-	-	21	7.4	156	-	4.6	.3	10	.3	96	96	172	-	-	285	7.8	-
2		1/70			.00	26	7.4	-	-	-	22	8.8	156	-	3.6	.3	11	.4	96	96	169	-	-	285	7.6	-
2		7/70			.02	27	7.0	-	-	-	22	6.4	167	-	2.2	.2	10	.3	96	96	192	-	-	255	7.3	-

SITE NO.	OWNER AND/ OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA-LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/ FIXED	DISSOLVED SOLIDS	SPEC COND.	PH	TOC
ACCOMACK COUNTY -		Continued																								
100-2		9/21/71			.01	24	8.1	-	-	-	22	7.2	154	-	2.2	.2	10	2.4	94	94	165	-	-	290	7.5	-
2		12/71			.01	25	7.2	-	-	-	24	6.3	168	-	2.6	.0	11	0.0	92	92	183	-	-	310	7.6	-
2		1/4/72			.11	25	7.0	-	-	-	23	6.8	164	-	1.4	.2	11	0.0	92	92	177	-	-	290	7.8	-
2		3/3/72			.10	23	8.0	-	-	-	22	6.9	162	-	2.4	.2	9.6	0.2	90	90	172	-	-	270	7.7	-
2		6/9/72			.09	23	7.2	-	-	-	25	6.6	162	-	1.2	.1	9.2	0.1	87	87	183	-	-	300	7.3	-
2		12/10/74			.1	30	8.1	-	-	.01	19	6.1	-	83	1.6	-	-	.01	94	-	181	35/146	151	-	7.4	9
3	Gulf Stream Nursery Wachapreague	12/29/68	304	174-194 204-224 252-267	.3	19	7.3	-	-	-	101	-	227	-	2.9	.1	62	.2	78	78	340	-	-	-	8.5	
4	Town of Onancock	1/14/58	165	106-156	.08	28	7.4	-	-	-	21	-	168	-	5.1	.8	17	-	99	99	193	-	-	-	7.4	
4		12/10/74			1.0	31	5.9	-	-	.02	15	5.2	-	126	2.6	.1	-	.01	92	-	209	38/171	208	-	7.5	
6	Byrd Packing No. 1 Parksley	12/9/74	294	170-215 236-266	1.3	40	9.7	-	-	.2	10	7.0	-	138	4.0	.1	-	.03	112	-	200	48/152	195	-	8.0	10
9	Holly Farms No. 4 Temperanceville	12/18/67	330	132-140 156-170 196-208	.5	32	8.7	-	-	-	14	-	156	-	12	.2	1.9	.4	127	116	181	-	-	-	8.3	-
9		8/5/69			.05	30	13.6	.023	-	.01	18	5.2	-	118	2.6	.34	12.5	.4	109	-	-	/152	-	-	7.4	

SWCB NO	OWNER AND/ OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA-LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/ FIXED	DISSOLVED SOLIDS	SPEC COND	PH	TOC
ACCOMACK COUNTY - Continued																										
10	Holly Farms No. 3	12/13/67	320	138-146 158-172 200-212	.5	34	9.2	-	-	-	14	-	164	-	2.1	.1	13.0	.4	136	123	194	-	-	-	6.9	-
10		3/22/68			.25	33	5.8	-	-	.01	9.2	1.3	-	123	1.5	.15	8.5	.04	-	-	288	180/108	-	-	7.7	-
11	Holly Farms No. 2	12/4/67	295	138-146 157-171 200-212	1.1	44	9.1	-	-	-	18.8	-	207	-	1.6	.8	14.0	.6	153	149	238	-	-	-	7.4	-
13	Town of Parksley #2	4/22/60	75	45-64	.06	13	7.4	-	-	-	18.7	-	18	-	58	.1	22.0	40	105	65	180	-	-	-	5.7	-
13		12/9/74			.1	15	8.7	-	-	.16	14.3	3.3	-	10	40	.1	-	8.5	66	-	174	34/140	170	-	5.0	3
14	Town of Parksley #3	4/22/60	90	45-78	1.49	18	9.4	-	-	-	10.6	-	32	-	29	.1	37	13.6	142	84	209	-	-	-	5.8	-
14		1/5/64			.01	11	7.0	-	-	-	10.7	-	12	-	43	.1	22	22.2	103	56	160	-	-	-	5.8	-
20	Perdue #4A Accomac	3/15/72	350	131-141 151-161 176-186 233-243 266-276	.15	29	2	-	-	-	7.5	1.5	100	-	6.4	.1	11	.1	80	80	135	-	-	205	7.7	-
20		12/11/74			.1	31	5	-	-	.01	.21	4.5	-	103	1.2	.1	29	.01	86	-	-	-	14.7	-	7.6	-
26	Perdue Foods #2	9/21/71	325	204-240 256-292	.02	21	9.8	-	-	-	22	10	134	-	1.8	.2	26	1.0	93	93	170	-	-	300	7.6	-

SWCB NO	OWNER AND/ OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA-LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/ FIXED	DISSOLVED SOLIDS	SPEC COND	PH	TOC
ACCOMACK COUNTY - Continued																										
26		12/11/74			.1	24	9.4	-	-	.01	16	9.2	-	109	1.2	.15	.23	.01	92	-	-	-	133	-	7.8	
28	Town of Chincoteague	2/65	262	217-245	.83	29	21	-	-	-	42	-	193	-	1.8	.2	62	.1	163	161	304	-	-	-	8.6	-
28		7/70			.00	40	12	-	-	-	48	21	234	-	4.6	.1	64	.7	150	150	319	-	-	519	7.3	-
28		6/1/72			.04	24	21	-	-	-	50	24	220	-	1.2	.1	65	4.6	150	93	313	-	-	590	7.6	-
29	Perdue Foods #3	7/22/70	325	202-238 258-294	.56	25	11	-	-	-	41	-	149	-	.4	.0	44	0.2	96	96	202	-	-	-	7.6	-
29		3/72			.06	23	10	-	-	-	17	9.1	132	-	3.2	.2	23	0.1	98	98	170	-	-	280	7.9	-
29		12/11/74			.1	26	10	-	-	.1	19	8.1	-	112	1.6	.14	31	.01	98	-	-	-	156	-	7.7	4
30	Perdue Foods #1	6/22/70	330	204-238 256-288 298-304	.56	25	12	-	-	-	42	-	166	-	.4	.7	48	.2	136	136	228	-	-	-	7.8	-
30		12/11/74			.1	27	11	-	-	-	27	11	-	124	.9	.18	36	.01	102	-	-	-	185	-	7.9	6'
33	VDH - Accomac	9/20/71	285		.01	9	5	-	-	-	66	10	172	-	2.2	.3	37	3.0	45	45	226	-	-	420	7.7	-
34	Mary Smith High School Accomac	3/70	295	275-295	.01	25	12	-	-	-	33	11	156		3.0	.2	43	1.6	110	110	212	-	-	410	7.6	-
35	Accomack Co. Accomac	9/21/71	295	275-295	.00	9	5	-	-	-	90	9	208	-	3.4	.4	55	2.4	42	-	282	-	-	520	7.7	-

SITE NO	OWNER AND/ OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA-LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/ FIXED	DISSOLVED SOLIDS	SPEC COND	PH	TOC
	ACCOMACK COUNTY - Continued																									
100-																										
40	C. C. Walker Comb. School	9/28/71	45		.05	21	10	-	-	-	10	14	144	-	1.4	.1	9	1.9	94	94	157	-	-	288	7.3	-
42	Acme Super-market, Onley	9/28/71	180	170-180	.04	25	8	-	-	-	13	7	142	-	2.0	.1	9	0.0	96	96	158	-	-	280	7.5	-
145	Peffer Accomac	7/71	177	167-177	.1	24	12	-	-	.01	56	12	-	139	1.2	.2	69	.2	104	-	-	-	261	-	7.7	5
161	Tangier Crab Company	6/69	991	971-986	-	2	.4	-	-	-	290	12	534	-	58	2.9	115	1.5	6	6	784	-	-	1319	8.2	-
161		6/72			.02	2	.7	-	-	-	310	8	511	-	61	2.4	130	1.9	8	8	805	-	-	1400	8.2	-
152	Town of Onley	3/72	190	170-190	.24	32	6	-	-	-	27	10	185	-	1	.2	10	.6	100	100	-	-	-	340	7.1	-
196	Holly Farms #5	9/11/69	365		.1	29	17.7	.15	-	.001	25	3	-	119	2			.04	99	-	-	-	-	-	7.4	.34
196		3/25/75			-	-								115	1.3	.14	7		106	-	172	54/118	166	-	7.3	5
211	Town of Onancock	9/48	210		.07	24	9	-	-	-	34	-	168		6.5	.1	15	2.9	95	95	203	-	-	-	7.9	-
265	Town of Chincoteague	12/48	40		.10	28	2	-	-	-	-	-	104	-	11	.0	19	0.2	78	78	156	-	-	-	7.5	-
265		8/2/73			.16	26	2	<.01	<.03	-	-	.89	-	11	13	.10	29	-	28	28	156	-	-	130	5.6	-

SWCB NO	OWNER AND/OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA-LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/FIXED	DISSOLVED SOLIDS	SPEC COND	PH	TOC
ACCOMACK COUNTY -	Continued																									
100-																										
213	Town of Tangier #1	3/3/66	915	900-915	.25	4.6	.2	-	-	-	-	-	521	-	13	2.8	1.5	3	12	12	808	-	-	-	8.6	
214	Town of Tangier #2	3/3/66	1033	1012-1027	.46	3.2	.1	-	-	-	-	-	515	-	22	2.5	2.0	6	9	9	783	-	-	-	8.6	
215	Town of Wachapreague	9/7/48	385		.14	6	4	-	-	-	180	-	346	-	5	.7	93	.8	29	29	482	-	-	-	8.1	-
216	New Church Rest Stop	3/67	132	120-130	.28	26	12	-	-	-	.16	-	174	-	1	.3	12	1.2	-	113	113	-	-	-	8.3	-
217	U.S. Coast Guard Metomkin Inlet	3/15/72	320		.02	26	32	-	-	-	2100	65	1270	-	29	.3	2600	5	200	200	5730	-	-	9580	7.5	-
218	Greenbriar Development	9/2/73	310	150-170	.22	143	23	<.01	<.03	-	-	14	186	-	.5	.11	16	.03	166	-	232	-	-	-	7.7	-
237	H. V. Drewer #1 Saxis	3/25/75	195	185-195	-	-	-	-	-	-	-	-	-	347	40	.13	44	-	330	-	1235	98/1137	1231	-	7.8	7
238	H. V. Drewer #2 Saxis	3/25/75	115	85-115	-	-	-	-	-	-	-	-	-	270	18	.1	65	-	334	-	513	112/401	498	-	7.4	8
249	Virginia Truck Exp. Station Painter	3/25/75	167	147-167	-	-	-	-	-	-	-	-	-	105	-	-	10	-	78	-	176	-	168	-	7.7	-

SWCB NO	OWNER AND/OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKALINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/FIXED	DISSOLVED SOLIDS	SPEC COND	PH	TOC
NORTHAMPTON COUNTY 165-																										
1	Northampton-Accomack Hospital	2/20/69	375	160-170 218-238 271-286	.08	24	10.3	-	-	-	16	-	142	-	.8	1.0	15	.3	102	102	158	-	-	-	8.0	-
1	Nassawadox	11/12/74			.1	26	-	.07	<.01	-	-	-	-	114	-	.15	20	-	106	-	231	0/231	227	-	7.4	-
2	Machipongo High School	11/1/74	365	211-221 248-259 291-302	.2	36	-	.21	<.01	-	-	-	-	96	-	.11	15	-	102	-	165	43/122	165	-	7.9	-
4	Capeville Elementary School	11/1/74	461		.4	47	-	<.01	<.01	-	-	-	-	118	-	<.1	17	-	118	-	219	65/154	219	-	7.6	-
5	Exmore Foods #7	3/6/67	240	142-157 188-218	.1	38	8	-	-	-	37	-	190	-	.4	.0	30	.0	118	118	231	-	-	-	8.2	-
7	Cape Charles Air Force Base	1/2/75	93	36-46	1.8	37	5.0	-	-	.1	15	.9	-	68	25	<.01	27	-	96	-	251	-	235	-	7.0	-
11	Cape Charles Air Force Base	1/2/75	65		.4	33	2.1	-	-	.06	-	-	-	71	9.2	-	26	.01	82	-	163	70/93	143	-	7.3	4
12	Cape Charles Air Force Base	1/2/75	58		1.1	30	2.7	-	-	.08	14	1.1	-	61	13.8	<.01	23	.03	74	-	146	65/81	136	-	7.0	3
13	Cape Charles Air Force Base	1/2/75	65		1.8	51	5.0	-	-	.1	15	.9	-	114	-	<.1	31	.01	142	-	243	-	-	-	7.5	6

SWCB NO	OWNER AND/ OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA-LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/ FIXED	DISSOLVED SOLIDS	SPEC COND.	PH	TOC
NORTHAMPTON COUNTY - Continued																										
165-																										
14	Town of Exmore #2	6/2/65	228	150-212	.19	23	8.1	-	-	-	63	-	254	-	.9	.4	17	.3	91	91	347	-	-	-	8.1	-
14		12/14/72			-	24	9.2	<.02	-	.01	51	10.5	-	189	2.2	.2	12	5.3	98	-	254	28/226	-	-	8.5	-
15	Town of Exmore #1	10/69	200	160-190	-	22	9.4	-	-	-	51	11	231	-	3.0	.4	14	.7	94	94	247	-	-	401	7.5	-
15		1/70			.0	25	8.9	-	-	-	55	13	236	-	3.4	.4	15	4.5	99	99	260	-	-	442	8.1	-
18	Custis Enterprises Nassawadox	11/1/74	300	93-98 152-157 265-270	3.0			.47	.02	-	-	-	-	78	-	.13	-	-	72	-	150	39/11	-	-	7.6	-
19	Custis Enterprises	11/1/74	308	97-102 175-195 246-251	See #18			COMPOSITE SAMPLE																		
21	Webster Canning Co.	11/1/74	265		.1	37	-	<.01	<.01	-	-	-	-	112	-	.11	30	-	112	-	-	67/166	230	-	7.5	-
22		11/1/74	280		See #21			COMPOSITE SAMPLE																		
23		11/1/74	295		See #21			COMPOSITE SAMPLE																		
23		4/17/75	295											73	2.8	.1	14	-	84	-	218	49/169	154	-	7.8	11
24		11/1/74	370		See #21			COMPOSITE SAMPLE																		

SWCB NO	OWNER AND/ OR PLACE	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA- LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/ FIXED	DISSOLVED SOLIDS	SPEC COND.	PH	TCC
NORTHAMPTON COUNTY - Continued 165-																										
25	Northampton-Accomack Hospital	4/12/74	321		.6	43	-	.14	.01	-	-	-	-	97	-	<.1	16	-	122	-	200	0/200	197	-	7.4	-
27	Cherrystone Campground	11/1/74	310	200-205 240-255	<1	32	-	.02	<.01	-	-	-	-	140	-	.27	205	-	166	-	648	130/518	645	-	8.6	-
28	Town of Cape Charles	9/69	80			45	3				17	2	129	-	28	.2	18	.0	124	18	204	-	-	328	7.9	-
28		10/72			.07	51	3				20	2	138		37	.2	23	.0	167	140	226	-	-	370	7.5	-
33	Exmore Foods #1	3/67	229		.3	41	10	-	-	-	152	-	220	-	.8	.0	208	.2	144	144	546	-	-	-	8.2	-
34	Exmore Foods #4	3/67			1.6	41	5	-	-	-	28	-	183	-	-	.0	24	.1	121	121	264	-	-	-	7.7	-
35	Exmore Foods #5	3/67	58		3.1	29	3	-	-	-	23	-	76	-	18	.0	41	.2	83	83	268	-	-	-	6.4	-
35		4/17/75												107	2.1	.18	25	-	122	-	186	23/163	182	-	7.4	6
36	Town of Eastville	7/48	146		.04	26	4	-	-	-	11	-	-	-	1	.1	17	.2	78	80	145	-	-	200	8.0	-
38	Town of Eastville	11/74	165	145-165	.1	29	-	<.01	<.01	-	12	.5	-	78	1.7	<.1	17	-	82	-	-	-	-	-	7.2	-
45	C & D Seafood & Oyster	4/75	185	165-185	-	-	-	-	-	-	-	-	-	105	1.1	.17	16	-	112	-	178	33/145	164	-	7.6	6

[illegible] AND [illegible]	DATE SAMPLED	WELL DEPTH	SCREEN DEPTH	FE	CA	MG	CU	PB	MN	NA	K	HCO_3	ALKA-LINITY	SO_4	F	CL	NO_3	TOTAL HARDNESS	CA, MG HARDNESS	TOTAL SOLIDS	VOLATILE/FIXED	DISSOLVED SOLIDS	SPEC COND.	PH	TOC
[illegible] COUNTY - Continued 165																									
54 C & D Seafood & Oyster	4/75		165-185		See #45					COMPOSITE SAMPLE															
4. Allen Smith Seafood, Oyster	4/17/75	186	158-186										107	2.1	.18	25	-	122	-	186	23/163	182	-	7.4	6
	4/17/75		158-186		See Previous Item				COMPOSITE SAMPLE																

APPENDIX D

Data From Special Chloride Survey

The following table contains specific chemical quality data from a special groundwater quality survey conducted during February, 1975, by the SWCB's Tidewater Regional Office. The purpose of the study was to determine irregularities in chemical quality with emphasis on chloride distribution. Additional data from Appendix C was included for easy reference. The data included in Appendix D include:

State Water Control Board Well Number
Owner and or location of well
The date the water was sampled
Total depth of well
Screen depths in well
Hardness
Chloride
Total Solids
Specific Conductivity
Nitrates

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY									
100-									
1	Town of Parksley #1	4/22/60	200	129-160	88	7	123	-	0.0
1		1/5/72			103	24	139	230	26
1		3/7/72			56	24	147	235	28
1		6/1/72			96	20	139	240	26
1		12/9/74			82	-	151	-	.03
1		2/24/75			76	7	132	190	-
2	Town of Onancock #2	7/69	282	108-123 130-145 160-188	100	10	190	288	.6
2		7/70			96	10	192	255	.3
2		1/4/72			92	11	177	290	.0
3	Gulf Stream Nursery Wachapreague	12/24/68	304	174-194 204-224 252-267	78	62	340	-	.2
4	Town of Onancock #1	1/14/58	165	106-156	99	17	209	-	.01

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
4		2/75			94	10	182	255	-
6	Byrd Packing No. 1 Parksley	12/9/74	294	170-215 236-266	112	-	200	-	.03
9	Holly Farms #4 Temperanceville	12/18/67	330	132-140 156-170 196-208	127	2	181	-	.4
9		8/5/69			109	13	-	-	.4
9		2/75			102	9	159	220	-
10	Holly Farms #3	12/13/67	320	138-146 158-172 200-212	136	13	194	-	.4
10		3/22/68			-	9	288	-	.04
10		2/75			102	11	175	259	-
11	Holly Farms #2	12/4/67	295	138-146 157-171 200-212	153	14	238	-	.6

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
11		2/2/75			152	2	199	290	-
12	Holly Farms #1	2/22/75	307	134-149 150-173 205-215	146	10	222	334	-
13	Town of Parksley #2	4/22/60	75	45-64	105	22	180	-	40
13		12/9/74			66	-	174	-	9
14	Town of Parksley #3	2/22/60	90	45-78	142	37	209	-	13.6
14		1/5/64			103	22	160	-	22.2
14		2/24/75			60	41	149	250	-
20	Perdue #4A Accomac	3/15/72	350	131-141 151-161 176-186 233-243 266-276	80	11	135	205	.1
20		12/11/74			86	29	-	-	.01
20		2/20/75			90	31	198	310	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
26	Perdue Foods #2	9/21/71	325	204-240 256-292	93	26	170	300	1.0
26		12/11/74			92	23	-	-	.1
26		2/2/75			96	23	174	290	-
28	Town of Chincoteague	2/65	262	217-245	163	62	304	-	.1
28		7/70			150	64	319	519	.7
28		6/1/72			150	65	318	590	4.6
28		2/27/75			146	56	295	519	-
29	Perdue Foods #3	7/22/70	325	202-238 258-294	96	44	202	-	.2
29		3/72			98	23	170	280	.1
29		12/11/74			98	31	-	-	.01
29		2/20/75			104	30	192	320	-
30	Perdue Foods #1	6/22/70	330	204-238 256-288 298-304	136	48	228	-	.2

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
41	Accomack Co. Nursing Accomac	2/20/75	142	-	114	12	222	320	-
42	Acme Supermarket Onley	9/28/71	180	170-180	96	9	158	280	0.0
94	Eastern Shore Seafood Leemont	2/26/75	182	-	94	8	169	260	-
97	Hemstettler Chesconnessex	2/26/75	102	-	102	13	225	335	-
109	Dr. White Onancock	2/24/75	110	-	32.6	109.0	242.8	420.0	-
137	Watkinson Locustville	2/20/75	212	-	92	10	179	290	-
145	Peffer Accomac	7/71	177	167-177	104	69	-	-	.2
161	Tangier Crab Company	6/69	991	971-986	6	115	784	1319	1.5
161		6/72			8	130	805	1400	1.9

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
162	Town of Onley	3/72	190	170-190	100	10	-	340	.6
183	Willett Leemont	2/24/75	238	-	114	38	244	380	-
195	Perdue #4	2/20/75	331	218-244 260-304	104	71	293	500	-
196	Holly Farms #5	2/27/75	365	130-138 152-166 196-204 214-222 226-234 270-285	94	11	165	239	-
211	Town of Onan-cock	9/48	210		95	15	203	-	2.9
265	Town of Chincoteague	12/48	40		78	19	156	-	.2
265		8/2/73			28	29	-	130	-
265		2/27/75			74	31	161	263	-
213	Town of Tangier #1	3/3/66	915	900-915	12	1.5	808	-	3.0

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
214	Town of Tangier #2	3/3/66	1033	1012-1027	9	2.0	783	-	6.0
215	Town of Wachapreague	9/7/48	385	-	29	93	482	-	0.8
215		2/20/75			30	90	458	760	-
216	New Church Rest Stop	3/67	132	120-130	-	12	113	-	1.2
217	USCG Metomkin Inlet	3/15/72	320	-	200	2600	5073	9580	5.0
218	Greenbriar Development Greenbackville	9/2/73	310	150-170	166	16	232	-	.03
224	Wade Moore Melfa	2/21/75	194	155-165 184-194	208	14	232	380	-
225	W. A. Coard Accomac	2/25/75	155	145-155	110	8	181	240	-
227	Archie Cropper Accomac	2/24/75	160	-	100	12	198	270	-
228	Walter Marks Accomac	2/24/75	298	226-246	82	1	212	260	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
229	J. W. Taylor Packing Co. (Comb. 2 wells) Hallwood	2/26/75	246	226-246	84	16	157	230	-
231	Baldwin Jenkins Bridge	2/28/75	140	135-140	96	21	212	360	-
233	Justice Horntown	2/75	165	150-160	66	27	157	240	-
234	Thornton Jr. Atlantic	2/75	300	285-300	112	11	185	331	-
235	Bishop Bloxom	2/26/75	157	147-157	94	11	155	199	-
236	Thomas J. Pinkine Modestown	2/75	220	-	96	10	153	210	-
237	H. V. Drewer Deep Saxis	2/75	195	185-195	338	430	1188	1850	-
237		3/75	195	185-195	330	44	1235	-	-
238	H. V. Drewer Shallow Saxis	2/75	115	85-115	276	66	485	710	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
238		3/75			334	65	513	-	-
239	Keith Miles Cashville	2/75	100	90-100	150	31	226	360	-
240	Campbell Keller	2/75	265	-	268	54	408	640	-
241	Miles, Kenneth Cashville	2/75	105	95-105	142	15	212	310	-
242	Tiernam Pungoteague	2/75	165	150-160	58	11	118	170	-
243	Fanton Painter	2/75	90	80-90	126	18	243	340	-
244	Holden Jenkins Bridge	2/75	220	212-220	204	960	1966	3510	-
245	E. S. Community College, Melfa	2/75	290	-	180	7	222	390	-
248	Fisher Osyter Company Sanford	2/75	140	100-140	204	87	380	614	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
249	Virginia Truck Exper. Sta. Painter	2/75	167	147-167	88	13	167	230	-
249		3/75			78	10	176	-	-
250	Groton Craddockville	2/75	175	165-175	88	15	187	260	-
251	Atkinson-Stauffer Bellhaven	2/75	208	198-208	100	13	214	340	-
252	Mapp, Quinby	2/75	210	-	88	45	305	460	-
253	Lyda, Olney	2/75	180	170-180	96	14	156	220	-
254	Taylor Wachapreague	2/75	130	-	130	14	224	330	-
255	Lankford Bloxom	2/75	265	-	84	10	145	221	-
256	Sterling	2/75	163	153-163	98	11	132	220	-
257	Huber, Harborton	2/75	165	155-165	92	57	290	520	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
ACCOMACK COUNTY - Continued									
100-									
258	Kelly New Church	2/75	259	-	84	11	157	230	-
259	Metcalf Mappsville	2/75	255	-	94	12	193	270	-
260	Fred Hall Hallwood	2/75	265	-	106	8	156	260	-
	Town of Chincoteague (Shallow wells near Shann)	2/75	40	-	42	11	113	158	-
	Page Fisher Oak Hall	2/75	250		24	31	292	480	-
	Gardise Devl Parksley, Test Well	3/75	300	280-300	84	12	164	-	0.0
NORTHAMPTON COUNTY									
165-									
1	Northampton-Accomack Hospital Nassawadox	2/20/69	375	160-170 218-238 271-286 296-301	102	15	158	-	.3
1		11/12/74			106	20	106		-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
NORTHAMPTON COUNTY – Continued									
165-									
2	Machipongo High School	11/1/74	365	211-221 248-259 291-302	102	15	165	-	-
4	Capeville Elementary School	11/1/74	461	no record	118	17	219	-	-
5	Exmore Foods #7	3/6/67	240	142-157 188-218	118	30	231	-	0.0
7	Cape Charles Air Force GATR Base	1/2/75	93	36-46	96	27	251	-	-
7		2/12/75			84	36	170	240	-
11	Cape Charles Air Force Base	1/2/75	65	-	82	26	163	-	.01
12	Cape Charles Air Force Base	1/2/75	58	-	74	23	146	-	.03
13	Cape Charles Air Force Base	1/2/75	65	-	142	31	243	-	.01
13	Cape Charles Air Force Base	2/12/75		-	144	32	263	360	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
NORTHAMPTON COUNTY - Continued									
165-									
14	Town of Exmore #2	6/2/65	228	150-212	91	17	347	-	.3
14		12/19/72			98	12	254	-	5.3
15	Town of Exmore #1	10/69	200	160-190	94	14	247	401	.7
15		1/70			99	15	260	442	4.5
15		2/18/75			122	14	215	330	-
18	Phillip Custis Eastville	11/1/74	300	93-98 152-157 265-270	72	-	150	-	-
18		2/18/75			78	63	284	500	-
18		4/7/75			78	12	134	-	-
21	Webster Canning Cheriton	11/1/74	265		112	30	-	-	-
22		11/1/74	280		See #21	COMPOSITE SAMPLE			
23		11/1/74	295		See #21	COMPOSITE SAMPLE			

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
NORTHAMPTON COUNTY - Continued									
165-									
23		4/17/75			84	14	218	-	-
24		11/1/74	370		See #21	COMPOSITE	SAMPLE		
25	Northampton-Accomack Hospital	4/12/74	321		122	16	200	-	-
27	Cherrystone Campground	11/1/74	310	200-205 240-255	166	205	648	-	-
28	Town of Cape Charles	9/69	80		124	18	204	328	.0
28		10/72			167	23	226	370	.0
33	Exmore Foods #1	3/67	229	no record	144	208	546	-	.2
34	Exmore Foods #4	3/67			121	24	264	-	.1
35	Exmore Foods #5	3/67	58	-	83	41	268	-	.2
35		4/75			100	105	342	-	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
NORTHAMPTON COUNTY - Continued									
165-									
36	Town of Eastville	7/48	146	-	-	17	145	-	.2
36		2/75		-	78	19	173	200	-
38	Town of Eastville	11/74	165	145-165	82	17	-	-	-
42	America House Kiptopeake	2/75	70	-	146	36	270	390	-
43	Holiday Inn Kiptopeake	2/75	220	200-220	94	15	178	230	-
45	C & D Seafood (Composite Sample)	2/75	185	165-185	114	19	199	280	-
45	Oyster	4/75		-	112	16	178	-	-
47	Webster Canning Cheriton	2/75	330	100-110 200-220 260-280	104	19	203	270	-
48	Town of Cape Charles	2/75	210	80-100 190-210	117	35	318	480	-
49	Nelson Daughty Willis Wharf	2/75	132	-	180	22	265	430	-

WELL NO.	NAME AND OR LOCATION	DATE SAMPLED	TOTAL DEPTH	SCREEN DEPTH	HARDNESS	CHLORIDE	TOTAL SOLIDS	SPECIFIC CONDUCTIVITY	NITRATES
NORTHAMPTON COUNTY - Continued									
165-									
64	C & D Seafood Oyster	2/75	185	165-185	See #45	COMPOSITE	SAMPLE		
64		4/75	-		See #45	COMPOSITE	SAMPLE		
66	P. C. Kellam Silver Beach	2/75	77	-	144	20	253	360	-
67	W. L. Chandler Jamesville	2/75	82	-	106	15	185	260	-
69	James Bradshaw Smith Beach	2/75	174	164-174	80	15	175	230	-
71	Harry Taylor Birdnest	2/75	160	-	100	20	188	260	-
	H. Allen Smith Seafood, Oyster 2 wells	4/75	186	158-186	122	25	186	-	-
	Gardise Meadows Eastville	12/74	310	-	111	168	450	-	0.0

APPENDIX E

Wells Affected by the Cone of Depression at Accomac, and Costs Incurred

The data includes well numbers and the costs incurred based on the owner's receipts unless an asterisk appears after the cost. An asterisk indicates that the cost represents a cost estimate made by a water well contractor but not necessarily the final cost. A low cost indicates that only a lowering of the jet setting in the well was required. Higher costs mean that in addition to a change in jet setting, jet pump had to be replaced and in some cases, a new well had to be drilled into the water table aquifer which required a water softener to remove hardness and iron. It is emphasized that this is only a partial list of affected wells, which was compiled by local residents, on August 13, 1971, to illustrate the problems occurring in the area.

WELLS AFFECTED BY THE CONE OF DEPRESSION
AT ACCOMAC, AND COSTS INCURRED

Affected Well	Cost Incurred	Type of Work Required
1	$342	?
2	$350	?
3	$565	?
4	$160	?
5	$827	Jet Setting New Jet Pump Shallow Well
6	$396	?
7	$500	?
8	$150*	?
9	$250*	?
10	$450*	?
11	$ 80	Jet Setting
12	$260	?
13	$472	?
14	$380 $317*	Jet Setting Shallow Well
15	$450*	?
16	$360	?

* This cost represents a cost estimate made by a water well contractor but not necessarily the final cost.

APPENDIX F

Groundwater Use

The following table is a listing of withdrawals by the larger groundwater users in the Eastern Shore Peninsula. The data includes the name and location of the system, which can be cross-referenced to Appendix A and B in order to determine well locations, the number of wells in service (x denotes an unknown number), and the groundwater withdrawals in million of gallons per day. Data was obtained from the State Water Control Board and the State Health Department.